

# 2010

## Annual Report

Sustainable agriculture  
for food and nutrition security

Bioversity International





# Contents

**Bioversity's *modus operandi* is based firmly on working with others, leveraging our funds and abilities so that we not only achieve results, but also help to build capacity in those we work with and for. So strong and plentiful are these links, however, that to list them all in every case would make for a very long and dry document. In the following stories some of our partners have been mentioned by name while others have not, but we would like to take this opportunity to thank them all. Bioversity depends on partnership and partners to get the job done. We also acknowledge the support of all our donors, especially those that contribute unrestricted funds.**

*Bioversity International is the operating name of the International Plant Genetic Resources Institute (IPGRI) and the International Network for the Improvement of Banana and Plantain (INIBAP).*

*Supported by the CGIAR*

Foreword	1
<b>Sustainable Agriculture</b>	
Tackling pests and diseases with biodiversity	2
Cherimoya: improvements along the tropical fruit value chain	6
Fusarium wilt: helping countries to protect themselves from disease	7
Bananas: identifying the obstacles to improved planting material	8
<b>Nutrition</b>	
Progress towards more sustainable diets	9
The challenge of better nutrition	11
<b>Conservation and Use</b>	
Future-proofing bananas – the <i>Musa</i> International Transit Centre	13
African cherry: securing a sustainable future for a medically valuable tree	16
International Treaty: helping to implement the multilateral system	17
GreenPhyl: an online tool to speed the search for useful genes	18
Noug: research to help an orphan oilseed blossom in Ethiopia	19
The International Year of Biodiversity	20
Board of Trustees	24
Finance Report 2010	28
Risk management	29
Restricted grants 2010	30
Selected publications	36
Projects	41
Establishment agreement	42

# Bioversity office locations



# Foreword

The year 2010 may come to be seen as a watershed in our history, both from a public awareness point of view and in the context of the CGIAR reform. The International Year of Biodiversity in 2010 allowed us to raise awareness among the general public and policy-makers of the importance of agricultural biodiversity to human lives and livelihoods.

We engaged in several events throughout the year, including our own extended celebration of agricultural biodiversity here in Rome, the Settimana della Biodiversità, and many important regional consultations that are helping to shape future priorities. By the end of the year, member countries of the Convention on Biological Diversity had adopted the Satoyama Initiative, which supports the conservation of landscapes and communities in which people manage biodiversity to supply their needs on a long-term, sustainable basis (see p. 20). In addition, with the UN's designation of the coming decade (2011-2020) as a Decade on Biodiversity, we are encouraged that Bioversity will be at the forefront of research on how to make better use of agricultural biodiversity to meet the challenges of the future.

On the CGIAR reform front, Bioversity's Board was one of the first to sign the agreement that established the Consortium of centres of the CGIAR in March 2010. The creation of the Consortium will improve the contribution centres can make to the CGIAR vision of reducing poverty and hunger, improving human health and nutrition, and enhancing sustainable management of natural resources in the developing world.

Bioversity's own part in researching the ways in which agricultural biodiversity can contribute to food and nutrition security continues. We appointed a Senior Scientist for nutrition, who has made great progress in working with stakeholders to draw up a nutrition strategy to guide Bioversity's work in this important field, and to recruit a panel of distinguished scientists to advise on implementation (see p. 9).

Nutrition is one area in which Bioversity's work is being integrated into the portfolio of CGIAR Research Programs (CRPs), the new vehicles intended to promote efficient and effective research collaboration among centres. Bioversity scientists have been closely involved in the development of 9 of the 15 CRPs, which are themselves at various stages in the approval process. As we engage in planning the CRPs we are already able to see the benefits of centres working more closely together, and as the CRPs are approved by the Consortium and funded they will support the bulk of Bioversity's research.

We also decided to strengthen our future by compiling a strategic business development plan based on internal consultations and inputs from a broad range of stakeholders. The objective is to sharpen Bioversity's research focus and to identify areas on which to concentrate in order to maximize impact. The outcome, expected to be completed by September 2011, will enable a new fundraising team to play to Bioversity's strengths as we seek support for the challenges and opportunities ahead. In further preparation, during 2010 Bioversity established a UK-registered charity as a tax-efficient vehicle to enable non-traditional donors to contribute to Bioversity research.

With sharpened Strategic Priorities for the next decade and the completion of the CGIAR reforms, Bioversity is well placed to play a key role in addressing today's challenges.

Emile Frison  
Director General

Paul Zuckerman  
Board Chair



# Tackling pests and diseases with biodiversity



Farmers and researchers in Ecuador.

**A global project—six crops in four countries—confirms that agricultural biodiversity can be an affordable and future-proof option for poor farmers to protect their harvests against pests and diseases**

Although accurate figures are hard to come by, pests and diseases clearly take a large bite out of global harvests. Estimates vary widely, from around 20% to 50%, or even more if one takes post-harvest losses into account. Equally clearly, poor farming families are hit hardest by these losses, as they depend more on what they themselves can grow, and cannot afford the pesticides and fungicides that are available to wealthier farmers. Modern varieties, bred for resistance, are another potential solution, but large areas devoted to genetically uniform plantings are an ideal incubator to force the evolution of new virulence in pests and diseases, and, again, poor farmers cannot afford to keep purchasing new planting material.

However, small-scale farmers in developing countries do have at their disposal and under their control a powerful tool to manage pests and diseases—one that is sustainable and ecologically sound, with none of the drawbacks of synthetic pesticides or uniform monocultures: crop biodiversity. Anecdotal evidence and scientific studies have shown that making use of this diversity, often by planting genetically diverse populations or mixtures of crop varieties, can help to buffer harvests against

the ravages of pests and diseases. Working with partners, Bioversity launched a major study to examine the ways in which farmers use crop biodiversity to manage pests and diseases, and looking at a range of crops and threats across four different countries. The study, funded by UNEP-GEF, Swiss Development Corporation (SDC) and FAO, has just finished a first phase. It concluded that for some crops, and some pests and diseases, crop biodiversity offers an attractive and sustainable solution to improve the management of pests and diseases.

## Globally useful tools

The project focused on six crops (banana, barley, common bean, faba bean, maize and rice) in four countries (China, Ecuador, Morocco and Uganda).

“The project was designed so that each crop was grown in at least two of the countries,” explained Devra Jarvis, the lead investigator on the project. “This allowed partners to develop tools and methodologies that could be used across countries at every site, so that results would be comparable.”

The project partners had previously agreed on two globally applicable

indexes—richness and evenness—that express the diversity used by a household and by a community. Richness reflects the number of varieties that a family or community uses, while evenness reflects the area planted to each variety; high evenness means that each variety covers roughly the same area, while low evenness indicates that one or two varieties predominate. The partners also developed globally-applicable guidelines for questionnaires designed to understand what the farmers know about the pests and diseases they face, and how they use agricultural biodiversity to manage these threats. For the objective evaluation of damage caused by pests and diseases, the partners agreed on a sampling procedure and scales to assess the severity of attack.

“With the agreed guidelines in place, the country teams were able to gather comparable data across crops and countries, which we are still analysing for common themes and results,” Jarvis said. “It is already very clear that small farmers can and do use crop biodiversity to protect against pest and disease attacks, and to reduce the probability that changes in pathogen or pest populations will cause crop damage in the future.”

## Levels of protection

Maize (*Zea mays*) in China showed very clear influence of evenness and richness of diversity on damage in farmers' fields. In the village of Zhao Jue in Sichuan province the 60 households grow a total of 8 traditional landraces and 14 modern varieties. Farmers there said that two diseases, Northern leaf blight and maize rust, and the maize borer pest were threats



Chinese farmer.

every year. The general picture from Zhao Jue showed that as the number and evenness of varieties increased, the average level of damage decreased. Even more striking, however, is the reduction in variance of the average disease damage as diversity increases. The more uniform farms may be fine if they happen to be growing a winning variety, perhaps one that is resistant to the prevailing pest or disease strain. If not, a change in the pest or disease hits uniform farms far worse. The results support what might be expected from a risk-management argument for the use of diversity against pests and diseases.

In Uganda, for common bean (*Phaseolus vulgaris*), things were not so clear cut. Three communities grew a total of 22 different varieties, with each family growing 2 or 3 kinds in its plots. The target diseases were angular leaf spot and anthracnose, and while richness and evenness did seem to protect against disease, the correlations were statistically more significant when incidence of disease was higher.

"The correlation between damage and diversity tends to be higher when the disease index is high," explained Carlo Fadda, project coordinator. "That's interesting because it means that when disease pressure is low there is no big difference between farmers who grow more varieties and farmers who grow fewer varieties. But when disease pressure is high, farmers who grow more bean varieties will benefit from the diversity in their fields by experiencing less overall crop damage."

Beans in Uganda and maize in China are just two of the individual studies that contribute to the project as a whole. Results from the other crops and other countries demonstrated the importance of diversity as a buffer against pests and diseases in some cases and not in others. This is to be expected on theoretical grounds (see Box on page 4) and further analysis will make it clear how farmers can best benefit from the use of agricultural biodiversity.

## Virulence, resistance and vulnerability

A crucial point in the relationship between crops and disease pressure is that there is diversity in both the virulence of the diseases and the susceptibility of the crops. The relationship between the two will determine the ecological and evolutionary dynamics of the system. For example, a variety may be totally resistant to one particular strain of a disease, but susceptible

to a different strain. If the disease mutates, or a new virulence strain arrives from outside the area, such a variety may be much less useful to farmers than one which is not totally resistant but which tolerates a wide range of disease strains. Alternatively, the very presence of many different kinds of host resistance could put pressure on the disease to evolve increased virulence, resulting in the ability to attack them all. For this reason a key element in the project was not only to ask farmers how they perceived the resistance of the varieties they used, but also to measure resistance and virulence in the laboratory.

Usually the farmers' perceptions of which varieties were most resistant matched those of the researchers, but there were also differences. In Morocco, for example, farmers at the three sites agreed on which of their faba bean (*Vicia faba*) varieties were most resistant to chocolate spot disease. Research results, however, often painted a different picture. At one of the sites, Tissa, farmers named four of their varieties as resistant. In glasshouse trials, there was no absolute resistance, but tests confirmed that although two varieties were indeed highly resistant, the other two were not. And the tests indicated that three varieties that the farmers considered susceptible were in fact resistant.

Each of the countries has been investigating variability in host resistance and pest and disease

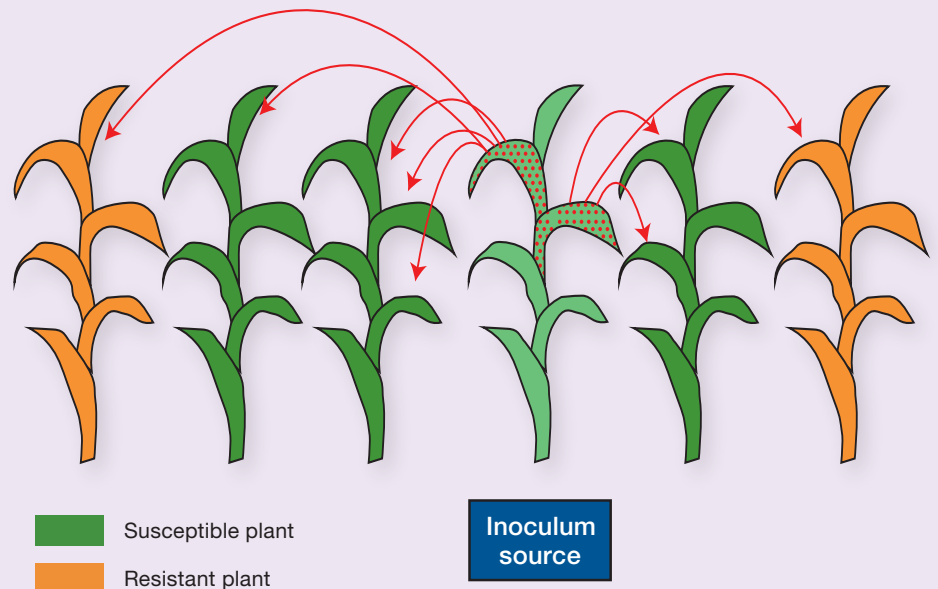


Moroccan women discuss their faba beans.



## When diversity is more useful against pests and diseases

There are good theoretical reasons why the use of crop diversity will not always be effective against pests and diseases, which were elaborated in a paper published in 1999 (Garrett KA, Mundt CC (1999) Epidemiology in Mixed Host Populations. *Phytopathology* 89: 984–990). The most important factors are probably the size of the individual host plants (more accurately, the contiguous area occupied by hosts of the same susceptibility genotype) and the distance over which the pest or disease can travel from one host to the next. If the host size is large, especially relative to the dispersal distance, then most propagules will end up on the already-infected host plant (auto-infection), and diversity is unlikely to offer much protection. If the host is small, and dispersal distance is great, propagules will fall on uninfected plants, and if these have a different genetic susceptibility then that diversity will protect against infection. Effectively, the presence of resistant plants acts



as a barrier to the spread of disease and dilutes the effective number of propagules. On that basis, one would expect good results with widely-dispersing diseases on small plants, and indeed agricultural biodiversity buffers crops well against rice blast and barley powdery mildew. Bananas, by contrast, are large hosts and so might be expected to be less protected by biodiversity. Similarly,

the short dispersal distance of nematodes and weevils, the main pests of banana, and of bruchid beetles on faba beans, suggests that agricultural biodiversity will be less useful in those cases.

virulence for its target crops, and this information will help to assess the vulnerability of farming systems to the appearance of a new pest or pathogen. Such new threats may arise by evolution or by the immigration of pests and diseases from outside the area, both of which will be affected by climate change. Tony Brown, a Bioversity Honorary Fellow at CSIRO Plant Industry in Australia and a technical advisor to the project, has studied the ways in which vulnerability might be measured and adjusted. Vulnerability is associated with mutation and migration and also with genetic uniformity, which could take two forms. There could be a lot of different varieties that all share the same genetic basis to their resistance, a problem of genetic homogeneity. Or a lot of the varieties present might respond in the same way to pest and disease pressure, a problem of low resilience. As the data on resistance

and virulence from the project's many sites are analysed and integrated, the results will help to inform a system for assessing and responding to vulnerability that makes the best use of agricultural biodiversity.

### Farmer knowledge

As with resistance and virulence, farmers differ in their understanding of the threats to their crops. So while Ugandan farmers had a good understanding of the pests and diseases, which they could see attacking their beans, they were not so familiar with nematodes (which are not visible to the naked eye) as a serious pest of banana. In two of the three Ugandan sites, for example, most of the farmers did not mention nematode worms as a potential problem, and yet researchers found clear evidence of nematode damage. "It is evident that farmers'

knowledge in this area is limited," said John Mulumba, project partner. Biodiversity could nevertheless be useful to them, if results from Ecuador prove applicable.

Farmers in Ecuador, like their counterparts in Uganda, have very good appreciation of variation in resistance of different varieties to banana diseases. Research results showed that while richness—the number of varieties—did not seem to influence damage levels, evenness did, with greater damage on farms dominated by a single variety. On-station trials also showed that varieties clearly differed in their susceptibility to banana pests and diseases. It should now be possible to devise cropping systems that use diversity by adding traditional varieties that are commercially attractive, thus offering double benefits: protection against pests and diseases, with opportunities to increase income.



More broadly, helping farmers to understand the biology that underlies the risks their crops face, especially if researchers can also offer biodiversity-based solutions to minimize those risks, will make a major contribution to improved food security.

Another important element for the researchers to learn about was the seed supply systems within which farmers operate, and so at each of the study sites participants shared information about where they obtained their seeds. This is particularly important for scientists so as to support farmers in their control of seedborne diseases. Farmers at all the project sites were very interested to see how their own local varieties compared with varieties from other parts of the country. There is also a need to make traditional varieties more readily available.

An important component of the project was to set up systems that would provide farmers with good quality, clean seeds and other planting materials of traditional varieties. It supported seed multiplication organizations, diversity seed fairs and local seed banks that provide high quality seed of traditional varieties in sufficient

quantities at the time the farmers need them for planting. These offer farmers access to diversified seed sources and increase the portfolio of varieties farmers can use in their production systems. The researchers also examined the constraints faced by farmers in accessing and storing seeds, including political and institutional implications, and incentives that that might be required.

Patterns of seed exchange can be very diverse. In Ecuador, bean farmers look for the biggest seeds that show no signs of damage, and they keep enough seeds for the next growing season. It is only when they lose their seed stock that they turn to neighbours, family and the wider community in which they live to get the seeds they need.

In Uganda, according to project partner Rose Nankya, the way farmers select and store seeds and exchange seeds and knowledge through their social relationships is at the heart of their strategy for coping with stress. The informal, traditional seed system is often strongest precisely in those areas that are most subject to stress, and getting seeds from multiple sources is a good coping strategy. As in Ecuador, Ugandan farmers tend

to select big, healthy looking seeds of typical colour and pattern, and to store them in a cool, dry place, but they also take care to dry them carefully and use substances such as ash and dried chilli peppers to protect the seeds against insect attack while in storage.

## Facing the future

The preliminary analyses coming from project partners working on different crops in different countries are providing further strong indications that agricultural biodiversity does indeed give poor farmers the help they need to protect their harvests from pests and diseases, at least for certain crops under certain conditions.

“This confirms our view,” noted Devra Jarvis, “that crop diversity represents an affordable and usable alternative to expensive chemical inputs, which is especially valuable to poorer farmers. It gives farmers a reason to conserve the biodiversity on their farms and in their communities, and is essentially future-proof because cropping systems based on biodiversity will be much more likely to adapt to climate change and changes in pathogen populations.”

A grand synthesis of all the data collected will surely identify more widely applicable general principles, and is eagerly awaited. The goal for future research is to get practitioners of integrated pest management (IPM) to think routinely about the use of agricultural biodiversity within their production and pest management systems. And breeders could usefully shift some of their attention from taking traits like disease resistance out of farmer landraces to put them into modern varieties, and instead think about improving the potential of existing landraces without sacrificing their protective diversity.

“In fact,” said Jarvis, “we think making better use of crop diversity in this way is a sustainable option for small-scale farmers from developed and developing countries.”

Ugandan farmer. Participation of farmers was a vital project element.



# Cherimoya: improvements along the tropical fruit value chain

## Bioversity Research

Promotion of sustainable cherimoya production systems in Latin America through the characterization, conservation and use of local germplasm diversity.

Supported by the 7th European Union Framework project and carried out with partners in Austria, Belgium, Bolivia, Ecuador, Peru and Spain.



Cherimoya (*Annona cherimola*) is a subtropical fruit with excellent nutritional properties and high potential to generate income for poor farmers in the Andes, its centre of origin. The overall goals of this project were to understand and conserve the genetic diversity of the species at the same time as promoting sustainable improved production strategies that could have a real impact on the livelihoods of Andean farmers.

Extensive genotypic molecular data and phenotypic characterization from more than 1500 individual trees in field collections, commercial plantations, home gardens and wild specimens in natural forests

were combined to build a picture of existing cherimoya diversity. This deeper understanding of cherimoya diversity—reflected in part in a newly developed standard set of descriptors—identified elite selections that could be used to improve production and also pinpointed areas for the conservation of diversity. At the same time, research into cropping practices helped farmers to improve their harvest. Fruit flies are the main pest, reducing harvests by up to 50%. In Bolivia, Ecuador and Peru, fruit fly damage cuts the gross value of production along the entire value chain by more than 25%, from € 14.1 million to € 10.2 million annually. The

project developed an integrated pest management (IPM) approach for fruit flies, such as removing infected fruit and other measures to improve sanitation. In Peru, for example, this IPM approach has effectively reduced the fly population from 13 flies/trap/day to fewer than 1.

As a result of improved quality, in Ecuador the market value of cherimoyas rose from US\$ 0.07/kg in 2006 to US\$1.00/kg in 2009. Other research along the value chain allowed local farmers to improve their income. In the case of southern Ecuador, this generated up to a tenfold increase.



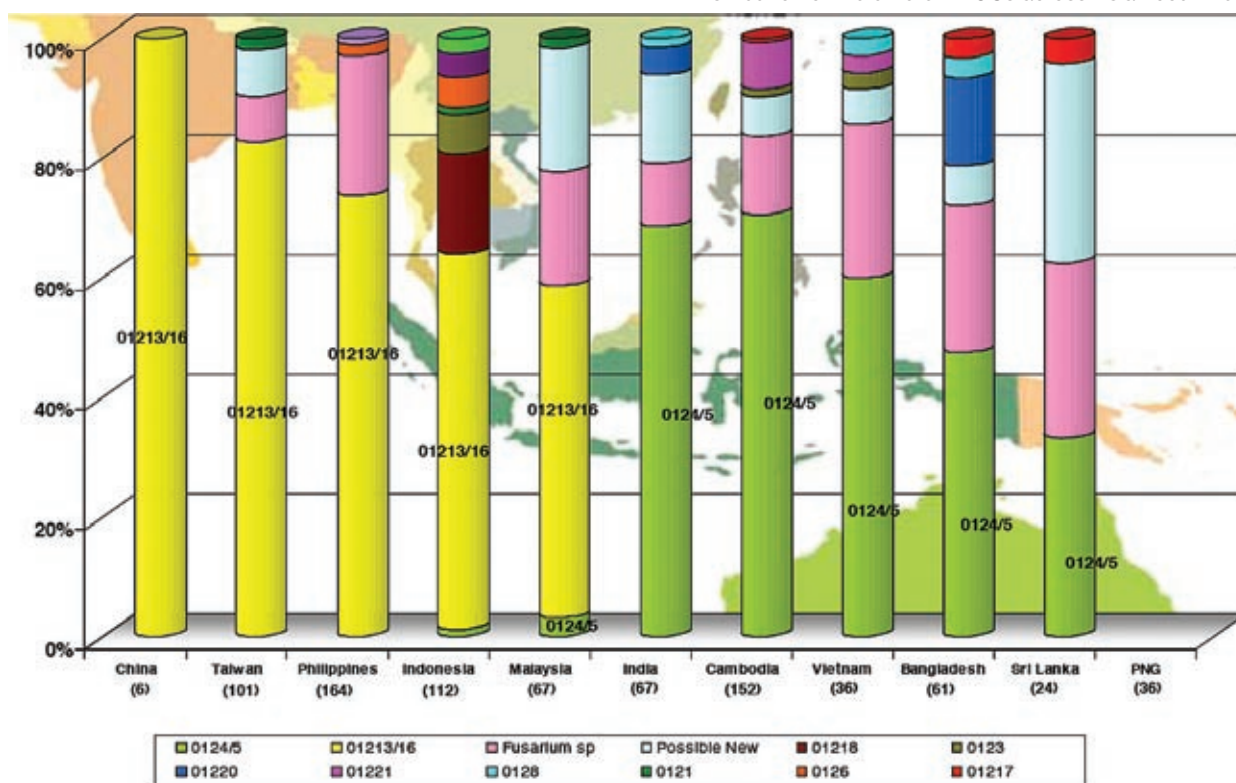
# Fusarium wilt: helping countries to protect themselves from disease

## Biodiversity Research

Mitigating the threat of banana Fusarium wilt: Understanding the agro-ecological distribution of pathogenic forms and developing disease management strategies.

Supported by ACIAR and carried out with partners in 12 collaborating countries from the banana network of Asia and the Pacific (BAPNET).

Distribution of the different VCGs across Asian countries.



Recent epidemics of Fusarium wilt (commonly known as Panama disease) in China and the Philippines pose a serious threat to the banana industry in Asia and beyond because they are caused by the virulent Tropical Race 4 (TR4) of the fungal pathogen *Fusarium oxysporum* f. sp. *cubense* (Foc). Tropical Race 4 is extremely important because it attacks the widely grown and traded Cavendish varieties and many local cultivars grown by small-scale farmers. Cavendish is resistant to Race 1 of Fusarium wilt, which wiped out commercial plantations in the 1950s. A vital element for countries trying to prevent the spread of Fusarium wilt

by means of quarantine is to know the geographical distribution of the different races. Race, however, is a somewhat subjective measure as it is based on strains being very host specific. The system breaks down when a strain infects hitherto unaffected varieties, as TR4 does. The vegetative compatibility group (VCG) concept is a more objective assessment that compares a new sample with known isolates of Foc.

In this project, Bioversity worked with partners in the 12 collaborating countries to establish baseline data for the geographical distribution of the various VCGs of Panama disease in Asia. Foc isolates were

extracted from diseased plants and characterized for their VCGs in laboratories in Australia and South Africa using an established standard technique. Nine VCGs were identified and VCG1213/16, to which TR4 belongs, was the dominant VCG in China, Indonesia, Malaysia, Philippines and Taiwan. It was not found in samples from the other countries. In Bangladesh, Cambodia, India, Sri Lanka, Thailand and Viet Nam, the dominant VCG was VCG 0124/5, which is associated with Race 1.

Countries now have more evidence to help them develop strategies to limit the spread of Tropical Race 4.

# Bananas: identifying the obstacles to improved planting material

## Bioversity Research

Strategies for strengthening the quality of banana planting material—a framework for national priority setting.

Supported initially by the Common Fund for Commodities and carried out in collaboration with the regional banana networks in Eastern and Southern Africa, West and Central Africa, and Asia and the Pacific



More than 95% of poor farmers who grow bananas replant with suckers from their own fields. Farmers save money with this low-cost strategy, but leave themselves increasingly vulnerable to the spread of pests and diseases, which often infest the suckers they use to plant a new field. The fact that farmers are accustomed to paying next to nothing for planting material is a serious barrier to the distribution of disease-resistant cultivars, to the routine availability of disease-free planting material and to the production of more uniform, market-oriented cultivars with specific characteristics wanted by consumers.

To help meet the enormity of the challenges of improving the quality of banana planting material, Bioversity collaborated with researchers in seven partner countries to develop guidelines for the identification of priorities and potential for strengthening national seed systems. Countries were profiled using a questionnaire designed to capture simple information about the quality and quantity of planting material and the extent of the formal mechanisms for deploying cultivars and multiplying planting material. Information from more than 30 countries, along with a review of scientific advances in pest and

disease management and genetic improvement, was used to generate a four-level decision tree to classify countries. We tested the decision tree for its ability to prioritize distinct and specific actions, and identified 12 different groups of countries with similar limiting factors, obstacles and opportunities for strengthening their system for cultivar deployment and planting material propagation. The approach is being mainstreamed into current and future grants to highlight this weak link in improving the livelihoods of small-scale farmers.



# Progress towards more sustainable diets



**Food and nutrition security are once again under the microscope as food prices climb beyond their peaks of 2007–2008. For poor people, who spend a great part of their income on food, high prices mean low nutrition. Bioversity has been examining ways to use agricultural biodiversity to deliver nutrition security.**

In November 2010 Bioversity teamed up with the Food and Agriculture Organization of the United Nations (FAO) to host an international scientific symposium on *Biodiversity and Sustainable Diets: United Against Hunger*. One aim of the meeting was to identify a clear and workable definition of what constitutes a sustainable diet. As part of that effort, scientists from around the world presented information ranging from the challenges and opportunities of edible insects to the potential of small fish species to improve nutrition.

The three-day event focused on the global challenge of biodiversity loss and ecosystem degradation, and the urgent need to re-examine food systems and diets.

Emile Frison, Director General of Bioversity International, set the tone at the opening session when he said that overcoming hunger and malnutrition needed a holistic approach. Frison called for “different sectors from agriculture to health to come together to set up comprehensive policies.”

Many presentations echoed this message, calling for a shift in focus from quantity to quality of food. Throughout the symposium, participants emphasized the vital links between the health of humans and the health of ecosystems, as well as the need, when appropriate, to promote ecosystems as a way to support sustainable diets through nutrition programmes, education and outreach, and policies and intervention.

“We must address the root causes of hunger and poor nutrition through food-system approaches,” Jessica Fanzo, Senior Scientist at Bioversity, said during her





A variety of nutritious and drought-resistant lablab bean (*Dolichos lablab*) used by people in Kitui, Kenya.



Monitoring the growth of children.

presentation. “Integrated policies and practices from different sectors, such as health and agriculture, hold promise for sustainable efforts in achieving the Millennium Development Goals and beyond.”

The symposium concluded with the unveiling of a draft definition of sustainable diets that included, among other things, the need to be protective and respectful of biodiversity and ecosystems, culturally acceptable, accessible, economically fair and affordable, nutritionally adequate, safe and healthy—while optimizing natural human resources.

In addition, the symposium called for a Code of Conduct to promote the use and marketing of ecosystems and food-based systems to improve human nutrition, particularly in poor rural areas. The code would be modelled on the Code of Conduct for the Marketing of Breast Milk Substitutes, and provide a framework for action to strike a balance between a food-based approach that includes using local biodiversity, and

the use of supplements, fortificants and ready-to-use therapeutic foods in emergency situations.

The definitions and proposed code of conduct are currently being discussed and revised, and should be published, with the proceedings, during 2011.

### From Definitions to Practice

A critically important factor in sustainable improvement of diets is redirecting agricultural systems from their current emphasis on quantity to ensure that they deliver better nutrition. We know from research by Bioversity and others that agricultural biodiversity can reduce costs of production and increase income for small-scale farmers, thus improving the livelihoods and quality of life of their families. Bioversity International is also undertaking research to better understand the role of agricultural biodiversity in providing access to food that is affordable and nutritious.



## The challenge of better nutrition

Almost a billion people are chronically hungry. More than a billion are overweight and obese. Type 2 diabetes, along with cardiovascular disorders, is rising fastest in poorer countries. About 670,000 children under the age of 5 years die each year from vitamin A deficiency, and 2 billion people suffer iron deficiency. Increasingly experts in the field talk of malnutrition in connection with both hunger and obesity, and the growth of malnutrition at both ends of the spectrum is one of the most pressing challenges facing humanity. Population growth, increasing urbanization, degraded ecosystems, social conflict and climate change all add to the difficulties. How can the world secure for all adequate food that is healthy, safe and of high quality, and secure it in an environmentally sustainable manner?

This question has exercised Bioversity in its work.

The underlying determinants of malnutrition have been well understood for decades. Tackling the root causes of malnutrition, however, means tackling problems

such as sanitation and education in addition to diet. Unfortunately the design, testing and scaling of more holistic packages that combine child and maternal care and disease control with nutrition-sensitive approaches, founded on agriculture, have been limited in their development and implementation. There is now a growing global desire to address the root causes of food and nutrition insecurity through wider, multisectoral approaches. Bioversity International believes that these approaches must include agriculture as the backbone of food production, and must be tailored to suit diverse conditions that reflect major agro-ecological, socio-economic and epidemiological circumstances.

Bioversity International has long been researching the practical benefits of using agricultural biodiversity to pursue different approaches to food production and consumption as a vital component of encouraging local farmers and communities to adopt change. Over the past year, the organization has sharpened its focus on food-system approaches to improving human nutrition and health, with the ongoing development

of a Nutrition Strategy to guide future research in this area. The subsequent programme of work will benefit from the guidance of an international steering panel of experts, and will concentrate on enhancing food and nutrition security through improved diet diversity and quality. This will contribute to improving the health and livelihoods of rural and peri-urban populations, and to ensuring the resiliency of ecosystems through sustainable use of agricultural biodiversity.

There are important yet unanswered questions that remain about agricultural biodiversity and its role in improving diet diversity and quality, ensuring nutrition security and promoting health benefits. We hope that through Bioversity International's continuing research, answers will become available and provide clarity for governments, development programmes, value chain and food sector actors, academic and research institutions, health and agriculture workers, and farmers and communities. Our ultimate goal is greater nutrition security for the poorest families

Bioversity International and its partners in India—including the M.S. Swaminathan Research Foundation and universities in Bangalore and Dharwad—have for many years been working with farmers on neglected and underutilized species in a series of projects supported by the International Fund for Agricultural Development (IFAD). Four research papers published in 2010 in the *Indian Journal of Plant Genetic Resources* demonstrate how this work has transformed the lives of marginalized rural people in southern India by helping them to grow more nutritious food for their families and communities, in some cases increasing yields by 70%.

The need for such research is great. Despite the productivity gains of

the Green Revolution, hunger is still widespread in India, which has seen virtually no change in malnutrition and has one of the highest levels of child stunting in the world. If households grew nutritionally-rich crops they could improve diets and curb malnutrition. Those same households struggle with rising food prices, environmental impacts caused by climate change, and have few options for new jobs. So options that combine better nutrition, increased yields and expanded job opportunities—based on locally grown grain that is proven to withstand harsh environments—offer potentially large positive impacts.

Bioversity and its partners worked with 200 farming families in the

four Indian states of Uttarakhand, Orissa, Tamil Nadu and Karnataka. Many of the farmers live below the official poverty line; the project set out to help them increase their income by increasing the production and commercialization of three millet species: little millet (*Panicum sumatrense*), finger millet (*Eleusine coracana*) and foxtail millet (*Setaria italica*). These species, by-and-large neglected by mainstream agricultural research and development, are well adapted to marginal environments. Steep hills, poor soils and unpredictable rain make life very difficult for these poor farming families, but millets can cope with these conditions. Millets are also more nutritious than mainstream cereals such as wheat and rice.



Indian women learn to make nutritious snacks that they can sell to boost their income.

Project scientists and farmers worked together on several fronts. The scientists were able to help the farmers improve their planting techniques, for example by spacing plants evenly rather than broadcasting the seed. The farmers contributed their traditional knowledge in efforts to select higher-quality varieties. And together, researchers and farmers established improved seed production and seed distribution systems. As a result, villagers were able to grow more food for their families and still have a surplus to sell. Some farmers were able to increase their income by 30% as a result of selling their surplus.

The project also worked with rural women to develop millet-based products for a wider consumer base. Training in quality standards, packaging and production helped the women to add value to the harvested grain. Millet-based recipes were developed into popular snack foods, which led to increased sales in urban markets. The new recipes are cost effective to produce, without being labour or time intensive, leaving the women

with more time for their other responsibilities. (See Bioversity International Annual Report 2009, pp 6-7.) Protein and vitamins are higher in these new recipes than in snacks made of rice or wheat, so in addition to increasing profits, they can also be used to combat the nutritional deficiencies that are particularly common among school-aged children. They also help the women directly. In one region, calcium levels were linked to their consumption of finger millet.

A similar product is an instant drink based on malted millet, or ragi. It tastes like hot chocolate, but is cheaper. Local hot chocolate powder sells for Rs 250 per kilogram (global brands top Rs 400 per kilogram), while the ragi malt marketed by the village women is only Rs 130 per kilogram. More importantly, from the point of view of the project, ragi malt is richer in minerals such as zinc, iron and magnesium and contains more vitamins, which doubles its appeal. A branded package created by the project can now be found on the shelves of high-end supermarkets and health-

food stores in Indian cities. Many women in the project process little millet into malt, and even this reasonably simple activity adds considerable value to the harvest. Profits tripled in some cases.

Individual impacts, significant though they were, are perhaps less important than the overall changes that greater empowerment of the women wrought. As a result of the various interventions, the women were able to generate substantial income, which they used to improve the welfare of their families. Increased self confidence, literacy and numeracy, and entrepreneurial spirit all helped to improve livelihoods.

The successes that Bioversity achieved with its partners in southern India stem from the holistic approach to the potential of local crops. The important message of this research, which has continued for several years now, is that it is indeed possible to improve peoples' livelihoods using local crops, such as millets. The benefits of agricultural biodiversity go far beyond diet and nutrition.



# Future-proofing bananas – the *Musa* International Transit Centre



**The *Musa* International Transit Centre (ITC) was set up at the Katholieke Universiteit Leuven (KULeuven), Belgium, in 1985 with the aim of maintaining and distributing banana and plantain diversity. The ITC now has well over 1200 accessions, including 19 wild relatives, and it distributes more than 300 of these each year as virus-free plantlets.**

After 25 years of operation, it is appropriate to ask how well the ITC serves the world banana community, and how could it perhaps be improved? In 2010, an evaluation report—*The impact of the Musa International Transit Centre – Review of its services and cost-effectiveness, and recommendations for rationalization of its operations*—was published. In essence, it gave the ITC a clean bill of health, listed its important impacts so far, and made a recommendation for the collection to be expanded.

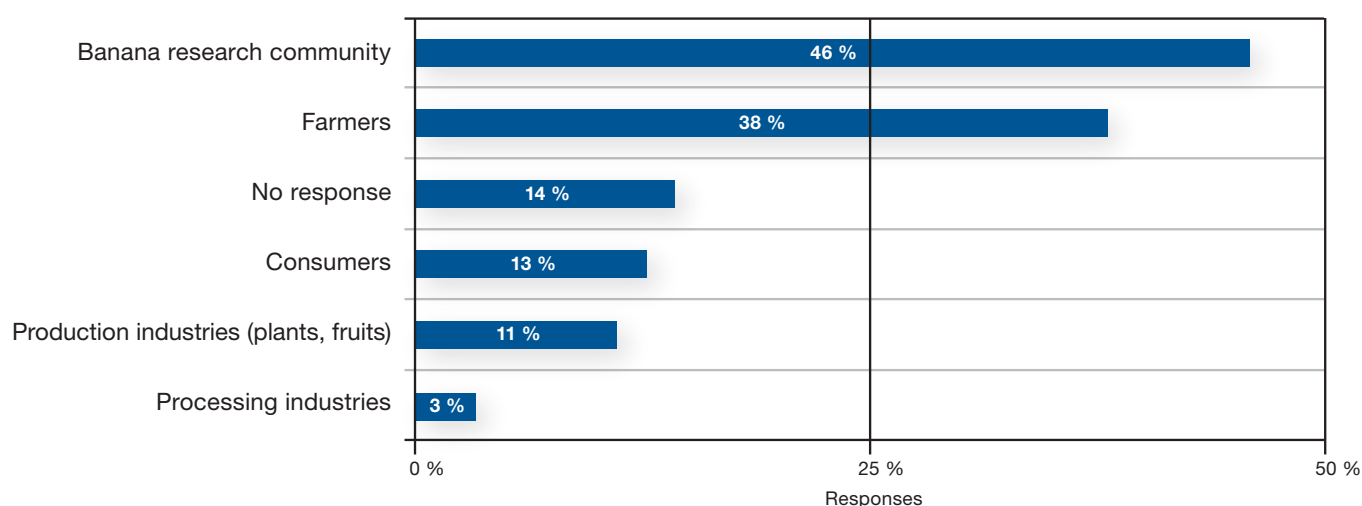
The report identified the most important areas to date where the ITC has achieved an impact as:

- The dissemination of superior germplasm to small-scale farmers, with expected positive effects on their productivity and throughout the value chain of production and processing of bananas.
- Research on resistance and tolerance to economically important banana pests and diseases.
- The supply of broad genetic diversity for the breeding of superior banana germplasm.

The importance of such achievements in the context of global food security is clear

when one remembers the crucial nutritional role of the banana and plantain harvest. Bananas are not only the world's most popular fruit, with a steadily increasing global production volume that exceeded 81 million tons in 2007 (FAOSTAT, 2008), but they are also the fourth main global staple, and thus an important food security crop for millions of resource-poor subsistence farmers in the tropics.

In recent years, globalization has reduced the diversity of *Musa* through the strong dominance of very few cultivars (notably 'Cavendish') in commercial production for international trade.



Who benefits from ITC material, according to survey respondents.

The increasing risks of the spread of biotic stress factors such as pests and diseases, and the dangers of abiotic stresses such as flooding, drought and poor cultivation practices, have led to severe losses in productivity, and even to the possible extinction of susceptible traditional cultivars.

There is thus a real need for the conservation of *Musa* diversity in genebanks and for wide exchange of diverse varieties to aid crop improvement to meet current and future challenges. This gives a clear role to the ITC, committed as it is to the long-term conservation of *Musa* genetic resources under the auspices of FAO and in the context of a global conservation strategy supported by the Global Crop Diversity Trust.

### Survey details

The study for the report received responses from 35 countries. Generally, respondents reported a high degree of satisfaction with the service provided by the ITC and highlighted its role as the most important global source of new *Musa* germplasm for research, as well as its significance in facilitating the safe distribution of improved material to farmers. Respondents appreciated the

diversity available for distribution, which they rated as unique among *Musa* genebanks, along with the easy accessibility of germplasm due to the free-of-charge service. The health status of the material received and the related health certification were also of high value to users. In some countries, the ITC is the only possible source of *Musa* germplasm because of strict domestic quarantine regulations. Nearly 40 percent of the survey respondents pointed out that they would not have been able to carry out their research or development projects without having access to the diversity from the ITC.

The study found that material is requested from the ITC for a variety of purposes: for breeding, fundamental research, characterization and evaluation, as well as for direct dissemination to farmers. Precise values for the actual numbers of farmers reached by the activities of the ITC are hard to come by, but are thought to be substantial. One study in Tanzania documented about half-a-million banana farmers there who benefited from ITC material between 1995 and 2004.

An analysis of the frequency of distribution of individual ITC accessions shows that resistance

## The full list of recommendations from the study

1. Expand the collection, especially with respect to wild species.
2. Encourage stakeholders to share germplasm to enhance the collection.
3. Establish or support existing regional collections for easier access and back-up function.
4. Continue with cryopreservation for backing-up the whole collection.
5. Use regeneration and field verification projects as starting points for further research on maintaining genetic integrity and eliminating off-types.
6. Improve documentation: upgrade with characterization and evaluation data and photographs.
7. Develop better links between ITC and the *Musa* Germplasm Information System (MGIS), updating and making MGIS more user-friendly.
8. Encourage more systematic feedback from users about germplasm evaluation results.
9. Establish regular updates on ITC activities, new germplasm or new information about germplasm available.
10. Reconsider the moratorium on the distribution of Banana Streak Virus-infested accessions by investigating the trade-off between risks and benefits, which are probably country and case specific.
11. Consider sets of accessions to be exclusively held in cryopreservation and eliminated from the *in vitro* collection.
12. Invest in characterization (morphological and molecular) and evaluation in order to increase germplasm use and to allow for rationalization.

to Black Leaf Streak Disease (BLSD) and higher productivity are the most demanded traits in cultivated materials. A whole range of improved varieties with BLSD resistance from the Fundación Hondureña de Investigación Agrícola (FHIA) breeding programme were widely distributed. The cultivar 'Yangambi km5', which is known to be highly resistant to BLSD, resistant to Sigatoka leaf spot, to *Fusarium* wilt race 1 and to nematodes, is also frequently demanded, followed by accessions of the commercial AAA cultivars ('Cavendish' and 'Gros Michel' subgroup). In addition to the distribution of material, users stressed the importance of germplasm conservation, especially as a safe back-up for national or regional *Musa* field collections.

And then there is the ITC's reference function. As the world's largest collection of *Musa* germplasm, with international recognition, the centre plays an important role for the research community as a reference collection. Given the characteristics of the crop and

the large number of synonyms for cultivars and varieties of *Musa*, this is an important function. The use of ITC accession numbers to refer to the specific germplasm or clone used for an investigation can help to ensure that research findings are reproducible from station to station and country to country.

Plant hygiene is very important, and encompasses two major activities. Even plants kept in tissue culture can harbour diseases within their cells, and the ITC has to take care that it does not distribute these diseases with the material it ships out. Researchers at the ITC have been instrumental in developing a range of techniques for testing for the presence of such diseases and, equally if not more importantly, for eliminating them. About two-thirds of the collection is currently disease free. Only those varieties are distributed, and the plantlets are checked for the presence of pathogens before they are sent out. Research is continuing to find therapies for the few viruses that still cannot be eliminated.

In its analysis of ITC operating costs, the study recommends reducing the number of cultures per accession that are maintained as *in vitro* cultures for medium-term storage, and substituting cryopreservation, which is cheaper in the long term, for medium-term conservation. Both the conservation and the distribution of *Musa* germplasm are expensive compared with crops conserved and distributed as seed, because constant monitoring, periodic sub-culturing and other maintenance and the multiplication of accessions on demand are all very labour intensive.

For the future, the evaluation report recommends that ITC invests in expansion to meet its commitment to the global conservation strategy and to the demands of its users. The report's analysis shows that a planned expansion of the collection to 2000 accessions over the next 10 years would cost about €1.4 million, with total annual operating costs rising from the current €750 000 to some €970 000.

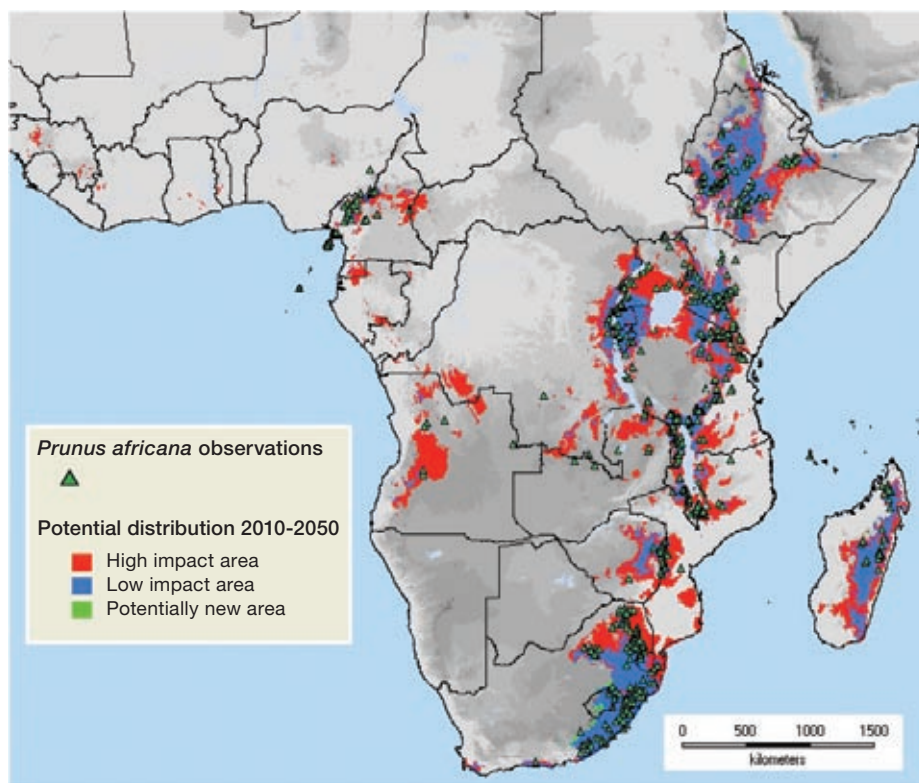


# African cherry: securing a sustainable future for a medically valuable tree

## Bioversity Research

Development of strategies for the conservation and sustainable use of *Prunus africana* to improve the livelihood of small-scale farmers.

Supported by the Austrian Development Agency and carried out by Bioversity International and the Austrian Federal Research and Training Centre for Forests, Natural Hazards and Landscape (BFW), with 8 national partners in Africa.



The bark of African cherry (*Prunus africana*) has become a valuable forest product since the discovery that it contains compounds useful to treat prostate disorders. In Cameroon, for example, the export trade was worth € 1.3 million in 2007. Unfortunately, the bark has been overharvested over much of Africa, resulting in a European ban on imports and leaving the poor farmers possibly worse off than before. The project set out to examine the genetic diversity of *P. africana* across Africa and to work with local farmers and country authorities to develop and document sustainable harvesting techniques.

The genetic analysis of 32 populations identified those in Kenya as being the most diverse, with the Rift Valley a barrier to migration. Furthermore, models indicated that climate change will make more than half of its current distribution unsuitable for *P. africana*. This information and much else was used to draft guidelines for conservation and use, and to help governments identify areas for protection, where both the diversity of the population and the threats to it make conservation a high priority. Data analyses of the bark revealed large differences in several of the active ingredients, so it may be possible to help farmers to select elite populations for the seedlings many are planting.

The project research resulted in guidelines for sustainable harvesting that will be published in 2011 and distributed widely to farming communities. The hope is that these will be applied and that governments will be successful in having the EU ban lifted, opening again the possibility that poor farmers can use the proceeds from *P. africanus* to invest in better health, education and improved livelihoods.

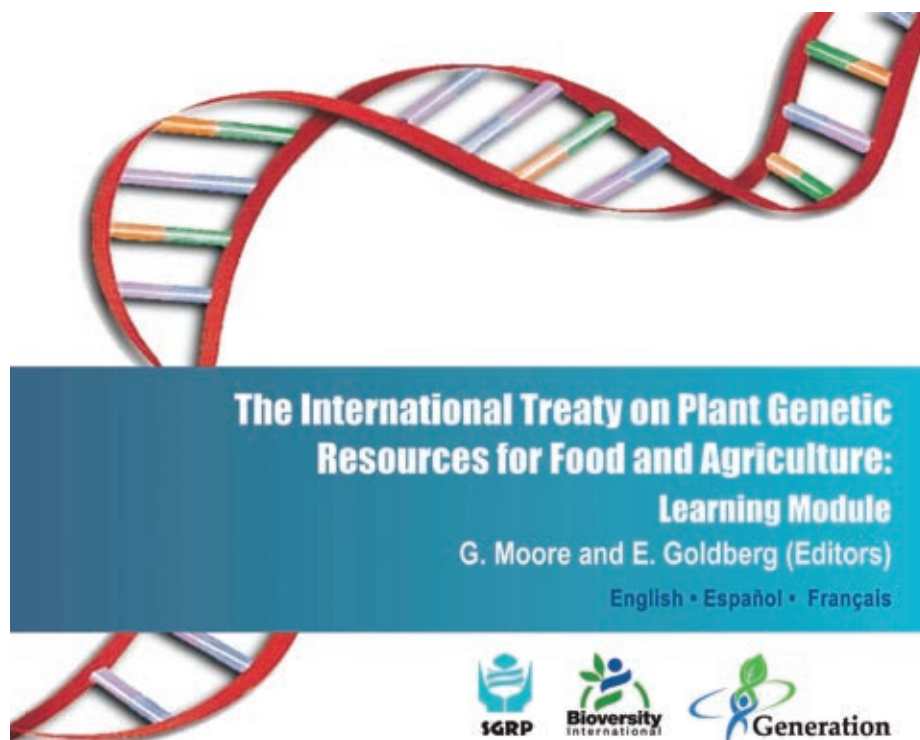


# International Treaty: helping to implement the multilateral system

## Bioversity Research

**International Treaty on Plant Genetic Resources for Food and Agriculture: Implementing the Multilateral System - Online learning module.**

Supported by the CGIAR System-Wide Genetic Resources Programme (SGRP) and the CGIAR Generation Challenge Program (GCP).



Developments in international and national law and policy over the past 15 years have significantly changed the working environment for those who make decisions about plant genetic resources. For example, collecting samples now requires an understanding of access legislation. Research on many aspects of plant genetic resources cannot be undertaken without considering relevant intellectual property rights, while benefit sharing has also become an important consideration.

One of the most important developments has been the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture and its Standard Material Transfer

Agreement (SMTA). The Treaty, in particular the multilateral system for access and benefit sharing, is the focus of a new online learning module produced by Bioversity International. The module aims to explain the Treaty in the context of other international agreements and offers practical advice on how to use the SMTA to exchange and give access to crop diversity. It was developed in response to a request from developing countries and the Governing Body of the International Treaty for help and capacity building relating to the implementation of the Treaty.

The module was designed to support a two-day workshop, but it has been structured so that the materials can also be used

separately to support classroom teaching or awareness-raising seminars. The material is available in English, French and Spanish, and includes practical exercises, background lecture notes, presentations, references to the full text of relevant laws and policies, and a bibliography for further reading. In addition there is a set of instructions, templates, tips, and step-by-step guidelines intended to help trainers to deliver a successful workshop or course.

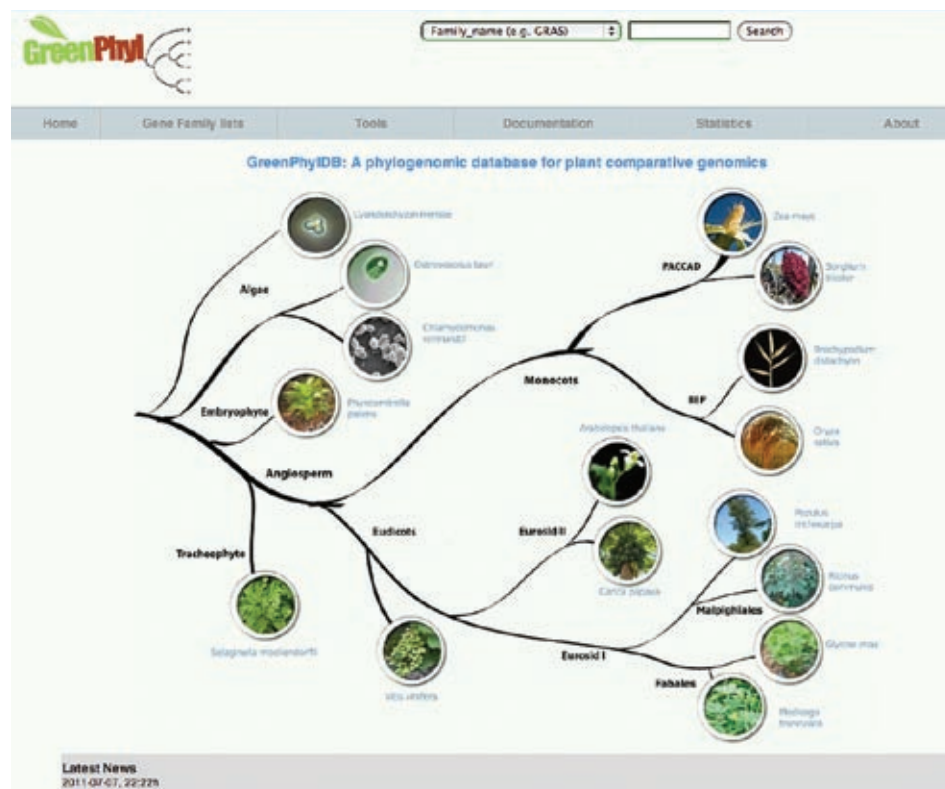
The module can be accessed online from the Bioversity Web site and a CD-ROM version is also available on request.

# GreenPhyl: an online tool to speed the search for useful genes

## Bioversity Research

Large-scale phylogenomic analyses for gene function prediction for GCP crops.

Supported by the Generation Challenge Programme (GCP) of the Consultative Group on International Agricultural Research (CGIAR).



Molecular data about plants is flooding out of laboratories at an unprecedented and accelerating rate. GreenPhyl is a research-oriented informatics tool developed by Bioversity that predicts the function of newly-discovered genes based on their phylogenetic relationship with genes of known function. It helps scientists to study gene evolution and function, and is intended to support breeders working to produce better-performing crops, by facilitating comparative functional genomics and accelerating gene discovery.

GreenPhyl was first developed by the French International Agricultural Research Centre

(CIRAD) as part of a two-year GCP-funded project. When funding ended in 2007, Bioversity took over development through a new collaborative GCP project. With CIRAD, Bioversity added 14 newly sequenced plant genomes to expand the range of GreenPhyl and started the manual annotation of more than 3 000 gene families (of the 10 000 still to be annotated). The partnership developed new tools, such as GOST (Greenphyl Orthologous Search Tool), which enables functional predictions even for plants that have not been fully sequenced. Bioversity improved the large-scale computational analysis of plant genomes by developing a new pipeline, and maintains and

improves the pipeline source code, database content and Web site.

GreenPhyl is being used extensively by scientists and has been applied by the French National Research Agency (ANR) and the Agropolis Foundation in research projects on genome annotation and crop domestication. It has been presented at a number of international scientific conferences, such as the Plant and Animal Genome Conference and is a component of the SouthGreen Bioinformatics Platform (<http://southgreen.cirad.fr/>).

GreenPhylDB version 2.0 is online through <http://greenphyl.cirad.fr>

# Noug: research to help an orphan oilseed blossom in Ethiopia

## Bioversity Research

Understanding and managing the genetic diversity of noug (*Guizotia abyssinica*) for its improvement.

Supported by the Canadian International Development Agency (CIDA) and carried out with the universities of Addis Ababa and British Columbia and the Ethiopian Institute of Agricultural Research.



Noug is a relative of the sunflower and a valuable but neglected oil crop of great importance to the small-scale farmers of Ethiopia and Eritrea. It grows well in difficult conditions and is part of traditional production systems, the oil is in demand domestically for cooking, and the seeds are also exported for bird seed. Despite these advantages, little formal research has been carried out to improve noug.

Bioversity and its partners collected samples of cultivated noug and its wild relative from across its range and interviewed farmers and intermediaries. Molecular characterization and phenotypic evaluation revealed greater

diversity within a farmer's field than among different farmers' samples. This reflects noug's breeding system; it is self-incompatible and regularly outcrosses. The biology of noug thus effectively hampers or even prevents farmers from selecting or maintaining improved varieties, because plants with valuable traits cannot easily be kept true to type. A collaborator at the Swedish University of Agricultural Science identified self-compatible lines that are being made available for future breeding efforts. The use of these lines in conjunction with the data on genotypic and phenotypic diversity generated by the project provides a sound basis for a well designed breeding

strategy for noug. A genetic map for noug will be completed soon and will allow the use of marker-assisted selection and comparison with the sunflower genome, thereby further contributing to noug improvement. Project data suggest that it will be possible to select for plants bearing more and heavier seeds. Reduced shattering, which causes seed loss before harvest, is another important breeding goal. Using environmental data from the sample collection sites, the project predicts that small areas in other African countries might also be suitable for noug cultivation, but that essentially Ethiopia and Eritrea are its natural home and could take greater advantage of this species.



# The International Year of Biodiversity



**The United Nations declared 2010 the International Year of Biodiversity. Emile Frison, Director General of Bioversity International, reflects on the events of the year, which culminated with the declaration of a Decade on Biodiversity.**

Was the International Year of Biodiversity a success or a failure? As an optimist, I like to think it was at least a qualified success, especially as far as agricultural biodiversity is concerned. The year started with almost no visible interest in the species that directly sustain human life. As I said in January, before the official launch of the IYB in Berlin, “the diversity of crops and livestock is absolutely fundamental to human survival and well-being. Agricultural biodiversity is not only vital for nutrition, it is also indispensable in meeting the challenges of climate change and in lifting poor people out of poverty.”

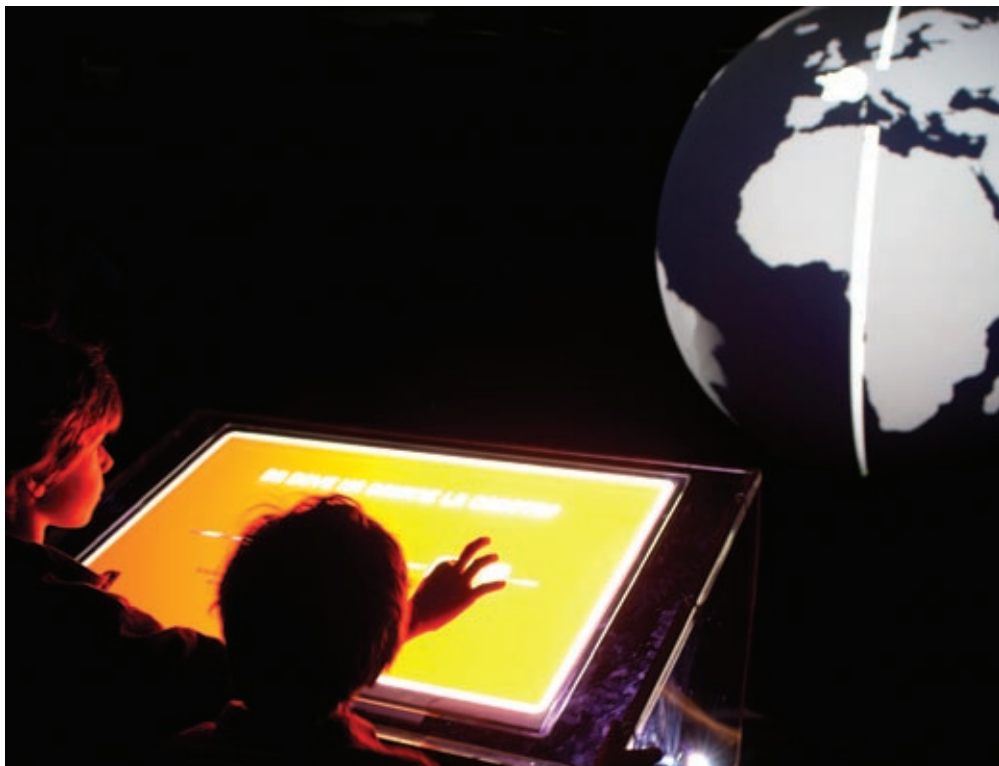
At the time these ideas seemed to fall on deaf ears, in public at least. In part this may be because for too long conservationists have tended to view farmers and farming as the enemy. While in many cases that may be true, the International Year of Biodiversity offered a great

opportunity to work towards more productive food systems based on biodiversity and a more ecological approach to agriculture. By the end of the year, the 10th meeting of the Conference of the Parties to the Convention on Biological Diversity (COP10) in Nagoya, Japan, had agreed to adopt and support the Satoyama Initiative. Landscapes that have been sustainably productive for hundreds, even thousands, of years have been recognized not only as worth looking after, but also as a source of wisdom and knowledge about how to make future agriculture more productive and more sustainable. And it is the farmers who both manage and are embedded in those landscapes that are the key to their long-term future.

## **Celebration of biodiversity**

Perhaps the Settimana della Biodiversità—an extended celebration of agricultural biodiversity





in Rome organized by Bioversity International and our partners—can take some credit for changed attitudes. Centred on the International Day of Biodiversity on 22 May, the events of the Settimana aimed to highlight the importance of agricultural biodiversity and the manifold links that bind agriculture to cultures, agricultural biodiversity to nutrition, and conservation to sustainability. Prominent people from around the world took part in lectures and roundtable discussions, activity workshops for children enthused the next generation, and a film festival organized by Crocevia, the Italian development NGO, kept the public entertained.

The Settimana climaxed on the International Day for Biodiversity, with a Call to Action from the Rome-based food agencies and their partners. Speakers from the International Fund for Agricultural Development (IFAD), the World Food Programme (WFP), the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGRFA) and the Food and Agriculture Organization of the UN joined Bioversity in calling on the world to invest in small-

scale farmers, rural communities, women and young people—all of whom have responsibilities for the conservation and use of agricultural biodiversity—to fight malnutrition, to build a more sustainable agriculture and to improve incomes. The Call for Action was endorsed by representatives of small-scale farmers and others.

### International events

Behind the scenes, the International Year of Biodiversity offered opportunities for ensuring that agricultural biodiversity received due attention from policy-makers and others. In Peru, for example, Bioversity International worked with the Ministry of Agriculture and the Ministry of the Environment to hold a meeting organized by Peru's Instituto Nacional de Innovación Agraria (INIA). Almost 200 people attended from more than 75 Peruvian organizations drawn from many different sectors. One outcome was a groundbreaking joint commitment by the Ministries of Agriculture and of the Environment to collaborate on the greater use of Peru's agricultural biodiversity to enhance economic and social development in their

country. The partnership between the two Ministries created a map of hotspots of agricultural biodiversity in Peru that was presented to COP10 in Nagoya. A decree establishing special zones for the protection of agricultural biodiversity, another suggestion to come out of the meeting, is currently awaiting signature by the President of Peru. Designated areas will be protected from activities that threaten the conservation and development of agricultural biodiversity, and will receive funds from the national budget.

In sub-Saharan Africa, the Forum for Agricultural Research in Africa (FARA) held its 5th Africa Agriculture Science Week in Burkina Faso. The meeting included a conference on Agricultural Biodiversity in Africa, jointly organized by FARA and Bioversity International, which again spearheaded efforts to ensure that policy-makers were aware of the multiple contributions that a wider use of agricultural biodiversity can make in agricultural research and development, and to ensure that locally-focused research strategies incorporate biodiversity, especially as the basis of better nutrition. These efforts are beginning to pay off, as demonstrated by a continuing dialogue between health and agriculture ministries in Burkina Faso, established through the West Africa Health Organization.

Similar progress was made in Asia, where a large symposium in Suwon, Korea, adopted a Framework on Agricultural Biodiversity Research and Development for the region. The Framework addresses key aspects of conservation, management and use of agricultural biodiversity in the region. Crucially, the discussions that resulted in this new Framework brought in farmers, scientists, NGOs and other stakeholders, so that the ideas in the Framework have wide acceptance and support. Similar efforts in India, Malaysia, the Philippines and Nepal, ranging from conferences and workshops to theatrical performances and art competitions, all helped to draw

attention to the importance of agricultural biodiversity within the more general realm of biodiversity conservation.

## Convention on Biological Diversity

The climax of the year was, of course, the Conference of the Parties in Nagoya. Going into the meeting we had two primary concerns. The Satoyama Initiative I have already touched on and indicated that it represents a positive step forward. It cements a rapprochement between farmers and conservationists, who I hope will now begin to work together more closely to ensure the effective conservation and use of agricultural biodiversity to improve the sustainability and productivity of farming systems while minimizing the threat to natural ecosystems. Our other concern was the Nagoya Protocol on Access and Benefit Sharing.

Bioversity had been involved in a long series of preliminary meetings, acting on behalf of the centres of the Consultative Group on International Agricultural Research to ensure that negotiators understood the importance of two key aspects of the protocol. It was vital that the protocol recognize the existence of the Multilateral System of Access and Benefit Sharing established by the International Treaty on Plant Genetic Resources for Food and Agriculture. We were worried that if it didn't it could store up conflicts between the Convention on Biological Diversity and the International Treaty. It was also important that the protocol leave room for more focused agreements in future, for example to deal with microbes.

Despite all the preliminary meetings and discussions, right until the last minute we were not sure of either what the protocol would contain or even whether it would be agreed. In the end, very early in the morning of the final day of the meeting we learned that not only had the delegates agreed the Nagoya Protocol but also that it met



Hrou Abouchrif,  
Guardian of Mediterranean Biodiversity.



our concerns fully. Furthermore, it provides for developed countries to police the use made of genetic resources, which should go a long way to restoring the trust so necessary to ensure that all can share the benefits to be derived from living resources.

On balance, then, I would say that the International Year of Biodiversity was a success. Of course, almost all the activities I have described, and many others for which there wasn't space, represent a beginning rather than an end. The United Nations itself has realized that this must be an ongoing process; COP10 invited the United Nations to extend the International Year into a Decade on Biodiversity, which the UN duly did. Between 2011 and 2020 there will be a focus on strategic plans for biodiversity, a set of Biodiversity Targets at international, regional and national levels, and public awareness activities.

Much still remains to be done, and Bioversity International will play its part. But just as there are no magic bullets to deal with all the challenges of sustainable agricultural development, so too there are no magic bullets to promote the wider adoption of agricultural biodiversity. The International Year of Biodiversity provided many opportunities to advance the agenda at different levels and in different places, and I remain optimistic that we will see further progress in the months and years to come.

Our future depends on it.





# Board of Trustees

**Bioversity is governed by a Board of Trustees that generally meets twice a year. The Board's duties include approving Bioversity's broad organizational framework. It also defines the organization's objectives and approves and monitors efforts to achieve these goals.**

**The Board appoints the Director General to act as Bioversity's chief executive officer. The Director General is responsible to the Board for Bioversity's operations and management and for ensuring that its programmes and objectives are properly developed and carried out.**



Paul Zuckerman, Board Chair, retired from full time investment banking in 1998. His expertise is in finance and agricultural economics and he spent six years as a Senior Economist at the World Bank. Before that he was a Research Associate at the International Institute of Tropical Agriculture in Nigeria. He is presently on the board of a number of international companies including ArcelorMittal Ltd in Brazil and Mexico; JM Financial Ltd and TechMahindra Ltd in India; and a number of BlackRock Hedge Funds.

He was Chairman of the Intermediate Technology Group (1990-95) and is presently Treasurer of The Art Fund in the UK.

Of his work with Bioversity, he says "I have always believed strongly in the importance of conservation to our own future, and perhaps nothing is as vital to that future as the continued availability of agricultural biodiversity."



Jeremy Burdon is an evolutionary biologist whose research encompasses problems involving pathogens of agricultural crops, using fungi as biological control agents for controlling invasive weeds and understanding the complexities of the interplay of parasitic and symbiotic interactions in natural systems. He has been Chief of the Division of Plant Industry of the CSIRO, Australia's national science agency, since 2003, and serves on the Executive Committee of the Borlaug Global Rust Initiative.

"With a rising world population and increasing aspirations for a better life, global food production needs to double within the next 50 years", he says. "Moreover, this increase has to be achieved against a backdrop of global climate change, increasing scarcity of water, declining land availability, and a need to make major changes to resource use to ensure the long-term sustainability of agricultural production. While many different approaches will be needed to achieve these goals, without doubt agricultural biodiversity is going to play an absolutely fundamental role in achieving all three needs – yield increases, nutritional requirements and sustainability of production".



Emile Frison became Director General of Bioversity International, and an ex-officio member of the Board, in 2003.

“What attracted me to my current responsibilities in Bioversity was the opportunity I saw to help Bioversity evolve from primarily a conservation agenda to an agenda where people, especially smallholder farmers in developing countries, are at the heart of our preoccupations.”

Dr Frison first joined Bioversity in 1987 to coordinate research on aspects of plant health in genebank collections; he was responsible for guidelines on the safe movement of living samples that are still widely used today. Before becoming Director General of Bioversity he served as Regional Director for Europe and Director of the International Network for the Improvement of Banana and Plantain, where he gave added impetus to research on this neglected crop.

“I believe that there is a tremendous untapped potential in mobilizing agricultural biodiversity to improve people’s lives through better nutrition, improved income and more sustainable and resilient agriculture.”



Peter Hazell has devoted most of his career to research and advisory work on policy issues related to agricultural development. Initially trained as an agriculturalist in England, he completed his PhD in agricultural economics at Cornell University in 1970 and then followed a distinguished research career in international agricultural development at the World Bank and the International Food Policy Research Institute.

His extensive and widely cited publications include works on the impact of technological change on growth and poverty reduction; the appropriate role of agricultural insurance in developing countries; sustainable development strategies for marginal lands; and the role of agriculture and small farms in economic development.

“The greatest contribution of agricultural biodiversity to meeting the challenges of the next two decades,” he believes, “is to help insure our future food supplies against major pest and weather risks. As a bonus, it can also contribute to improve diets, farm incomes and the sustainability of farming systems.”



Phindile Lukhele-Olorunju is currently Director of Research and Innovation at the University of Venda in South Africa. She understands first hand the importance of Bioversity’s work.

“Climate change is a reality that African farmers have come to accept,” she says. “They realise each year that they need to grow new varieties and crops that can adapt to the changes in seasons, temperatures and rainfall patterns. Agricultural biodiversity provides and will continue to provide the necessary varieties and species that can adapt to the various environments and meet the food needs of the farmers.”

Professor Lukhele-Olorunju trained in Nigeria in Plant Breeding, Plant Pathology, Virology and Agronomy. As a researcher in Nigeria, she bred improved groundnut varieties for west Africa before moving into research management with international organizations, including USAID and other CGIAR centres. From 2002 to 2008 she was responsible for three research institutions at the Agricultural Research Council of South Africa.



Trish Malloch-Brown is an independent humanitarian affairs consultant based in London, active on the Boards of many organizations. She was Vice Chair of the Refugees International Board for 12 years and has been an active supporter since 1986, when she worked at the Sawyer Miller Group, a New York-based strategic and political consulting firm. She is also a co-founder of the Washington Circle, an outreach group targeted at women who are interested in humanitarian affairs, with groups in Washington DC, New York, Wyoming, Illinois and Massachusetts. Lady Malloch Brown holds a BA in Political Science from Denison University and a Masters in International Affairs from the School of International and Public Affairs at Columbia University in New York.

"I am particularly attracted to Bioversity's idea of working closely with poor farmers to improve their livelihoods and health," she says, "because this is a natural extension of my interests in human rights and development."

Luigi Monti is the Government of Italy's representative on Bioversity's Board and a Professor in the Soil, Plant and Environment Sciences Department at the University of Naples. He is also Director of the Research Institute for Vegetable and Ornamental Breeding of the National Research Council and coordinates 50 Research Units in an Italian Strategic Project on Agrobiotechnology.

Professor Monti is familiar with the CGIAR, having been a Board member of the International Center for Agricultural Research in the Dry Areas (ICARDA) in Syria and leader of an international programme on cowpea in collaboration with the International Institute of Tropical Agriculture (IITA) in Nigeria.



Shivaji Pandey was born and raised in India, and gained his MS and PhD in Plant Breeding and Plant Genetics from the University of Wisconsin, USA. He is familiar with the CGIAR, having been Director of Maize Program and Director of African Livelihoods Program at CIMMYT in Mexico, and has been at FAO in Rome since 2005. He is currently Director of the Plant Production and Protection Division at FAO. The division works on crop production and quality to enhance food security and livelihoods, especially among the rural poor. It is also the locus for participation in international treaties and agreements to do with agricultural biodiversity and food security.

"Although I serve on the board as an ex-officio member designated by FAO," Pandey says, "I like Bioversity because this is one global research organization that takes a holistic approach to managing and using biodiversity for well-being today and tomorrow; others look at one or a few components."





Cristián Samper is the Director of the National Museum of Natural History of the Smithsonian Institution in Washington DC. He is thus responsible for managing the largest natural history collection in the world (126 million specimens and artefacts), overseeing scientific staff who produce more than 500 research publications each year and hosting more than six million visitors annually. He chaired the scientific advisory body of the United Nations Convention on Biological Diversity, leading the Millennium Ecosystem Assessment study. He has published and lectured extensively around the world on topics related to conservation biology and science policy, and is a Fellow of the National Academy of Sciences of Colombia and the Academy of Sciences for the Developing World.

Of his interest in Bioversity's work, he says, "Changes in biodiversity have been part of the backdrop to human evolution, with crop domestication a prominent example. I am concerned that we do not lose any more of the agricultural biodiversity so essential to our future."



Luis Téllez holds a BA in Economics from the Instituto Tecnológico Autónomo de México (ITAM) and a PhD in Economics from the Massachusetts Institute of Technology (MIT). He is currently Chairman of the Board and CEO of the Mexican Stock Exchange and has served at the highest levels in the Mexican government, including a period as Deputy Secretary of Agriculture. Téllez drafted the law that allows communal land holders to turn their ownership to full property rights, and which also clearly defined full propriety rights to the Mexican rural lands, and was responsible for negotiating the agricultural sector in NAFTA.

"I am happy to serve on the Bioversity Board, because just as secure rights over land are important for human development, so too is the use and conservation of agricultural biodiversity, another natural resource that poor rural farmers can use to improve their livelihoods."



Antonio La Viña is an internationally-renowned environmental lawyer and Dean of the Ateneo School of Government in the Philippines. He is an expert on climate change who chaired the negotiations on reducing emissions from deforestation and land degradation (REDD-plus) at the 2009 Copenhagen Climate Conference and successfully forged an agreement, which was adopted in Cancun in 2010. He also has an abiding interest in governance and pioneered the use of consensus-building approaches in resolving environmental conflicts over water, forestry, sustainable agriculture, coastal and marine resources and other issues of importance to indigenous communities. He is passionate about the importance of agricultural biodiversity.

"In the six years I have been a member of the Board of Bioversity International, I have become convinced that maintaining and enhancing agricultural biodiversity has to be a cornerstone of sustainable development; conversely, if agricultural biodiversity is lost or eroded, the world would suffer greatly and poor communities most of all."

# Finance report 2010

## Careful management enabled Bioversity to rebuild its surplus despite continuing uncertainties about currencies and levels of support.

The year ending December 2010 was another busy but rewarding year for Bioversity. The CGIAR's Change Process continued. Bioversity is actively contributing to the development of several CGIAR Research Programs (CRPs), the new vehicles that will promote efficient and effective research collaboration among the centres. Bioversity scientists are closely involved in the development of nine of the CRPs. Each is at a different stage of development, and as they are approved by the Consortium and funded they will support the bulk of the Bioversity's work in the future.

From a financial perspective, 2010 was also a challenging year. The continuing uncertainty brought about by the impact of the global financial crisis and the fluctuating Euro/US\$ exchange rate meant that finances had to be managed very carefully. Revenue in 2010 amounted to \$38.1 million (2009: \$35.8 million) against expenditures of \$37.2 million (2009: \$36.3 million) resulting in an operating surplus of \$954 000 for 2010. The financial impact of the operating surplus has been to increase Bioversity's reserves to \$9.1 million, equivalent to 90 days of normal operation, which was a target set by the Board for management at its September 2007 meeting. Bioversity's liquidity reserve level of 134 days exceeds the CGIAR recommended range of 90–120 days.

Bioversity is taking further steps to secure its future, with the decision to compile a Strategic Business Development Plan. Consultants are helping senior management and a core team of

scientists to sharpen Bioversity's research focus and identify areas on which to concentrate. The process is being informed by a Positioning Analysis, in which more than 30 donors from private and public spheres, research and implementation partners and

## Donors supporting Bioversity with unrestricted funds, 2009 and 2010

	2010	2009
Australia	418	243
Belgium	1245	1130
Canada	1282	882
China	130	130
France	404	430
Germany	443	
India	75	75
Iran		9
Ireland	680	702
Italy	2439	2342
Japan		12
Korea Republic of	40	40
Malaysia		10
Netherlands	2114	2254
Norway	1060	825
Philippines	18	20
Portugal	150	125
South Africa	40	40
Sweden	767	754
Switzerland	1402	668
Thailand	10	10
United Kingdom	1995	1652
USA	350	250
World Bank	1260	1680
Total - Unrestricted Grants	16 331	14 274

# Risk management

global thought leaders have shared their perceptions of Bioversity and outlined what they see as the challenges and opportunities ahead.

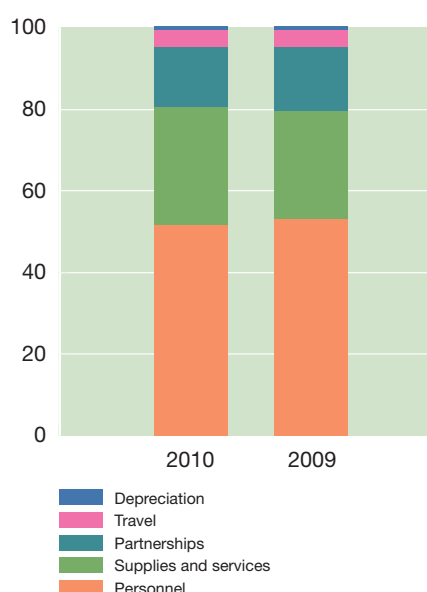
**Gerard O'Donoghue**  
Director, Corporate Services

## Top 20 donors to Bioversity in 2010

	US\$'000
Netherlands	4305
European Commission	3477
Belgium	2957
UNEP-GEF <sup>1</sup>	2547
Italy	2439
World Bank	2409
United Kingdom	1995
Switzerland	1496
Canada	1307
Global Crop Diversity Trust	1197
Norway	1060
European Countries	984
Germany	970
FAO	850
Sweden	771
IFAD	764
Ireland	680
Australia	631
The Christensen Fund	551
The Bill and Melinda Gates Foundation	524

<sup>1</sup> United Nations Environment Programme/ Global Environment Facility

## Breakdown of total expenditure (%)



Bioversity's Board of Trustees has responsibility for ensuring that an appropriate risk management system is in place that enables management to identify and take steps to mitigate significant risks to the achievement of the organization's objectives.

Risk mitigation strategies are ongoing at Bioversity and include the implementation of systems of internal control which, by their nature, are designed to manage rather than eliminate the risk. The organization also endeavours to manage risk by ensuring that the appropriate infrastructure, controls, systems and people are in place throughout Bioversity.

The Board has adopted a risk-management policy that has been communicated to all staff together with a detailed management guideline. The policy includes a framework by which Bioversity's management identifies, evaluates and prioritizes risks and opportunities across the organization; develops risk-mitigation strategies that balance benefits with costs; monitors the implementation of these strategies; and reports on results, in conjunction with finance and administration staff and internal audit, semi-annually to a Task Group of the Board and annually to the full Board.

The Board is satisfied that Bioversity has adopted and implements a comprehensive risk-management system.



# Restricted grants 2010

For the Year Ended December 31, 2010  
(US dollar 000s)

<b>ACIAR</b>		
Integrated crop production of bananas to manage wilt diseases for improved livelihoods in Indonesia and Australia	213	
<b>Alliance of the CGIAR Centers</b>		
Central Advisory Service on Intellectual Property—CAS-IP	150	
<b>ASARECA</b>		
Enhanced management of Banana Xanthomonas Wilt for sustainable banana productivity in East and Central Africa -USAID portion	70	
Sustainable Management of Banana Xanthomonas Wilt in Banana Cropping Systems in East and Central Africa	22	
Enhanced management of Banana Xanthomonas Wilt for sustainable banana productivity in East and Central Africa -World Bank portion	62	
Subtotal	154	
<b>Austria</b>		
Developing training capacity and human a management of forest biodiversity	129	
Sustainable futures for indigenous smallholders in Nicaragua: Harnessing the high-value potential of native cacao diversity	52	
Sustaining Forest Resources for People and the Environment in the Niassa National Reserve in Mozambique	155	
Development of strategies for the conservation and sustainable use of <i>Prunus africana</i> to improve the livelihood of small-scale farmers	74	
Growing bananas with trees and livestock: Young farmer business groups improve crop and natural resource health and market links for rural well-being	109	
Subtotal	519	
<b>Belgium</b>		
Improving agriculture-based livelihoods in Central Africa through sustainably increased system productivity to enhance income, nutrition security, and the environment - CIALCA II	800	
Support for maintaining the International <i>Musa</i> Collection	912	
Subtotal	1712	
<b>Brazil</b>		
Establishment of the International Coconut Genebank for South America and the Caribbean	0	
Amazon Initiative research activities	13	
Subtotal	13	
<b>CAPri</b>		
Agrobiodiversity conservation service and implications for collective action and property rights	41	
<b>CATIE</b>		
Impact of value chain approaches on poverty: the introduction of a new plantain variety in the Dominican Republic	10	
<b>CFC</b>		
Cocoa productivity and quality improvement: A participatory approach	73	
Cocoa of Excellence: Promoting diverse high quality cocoa origins	70	
Promotion of exports of organic bananas in Ethiopia and Sudan	106	
Subtotal	249	
<b>CGIAR CSO Programme</b>		
Native cacao in northern Ecuador: Using native cacao to reduce poverty and conservation of globally important biodiversity in northern Ecuador	3	
<b>China</b>		
Strengthening the research capacity on agricultural biodiversity and updating facilities and related projects at the CAAS-Bioversity Centre of Excellence for Agrobiodiversity	38	
<b>Christensen Fund</b>		
A voice for Vavilov: Using modern means of communication to address cultural and agricultural biodiversity and promote a global conversation	52	
Funding of two round table discussions related to agrobiodiversity at La Settimana della Biodiversità, a week-long celebration of biodiversity in Rome as part of the international year of biodiversity	25	
Indigenous Partnership for Agrobiodiversity and Food Sovereignty	350	
Climate change and indigenous communities: Strengthening adaptability, resilience and innovation	124	
Subtotal	551	

<b>CIAT</b>		<b>European Countries</b>	
CCAFS - Adaptation and Mitigation Knowledge Network	92	ECPGR—Phase VIII	788
<b>CIDA</b>		EUFORGEN—Phase III	196
Global Plan of Action implementation in selected sub-Saharan Africa countries	13	Subtotal	984
CGIAR–Canada linkage fund: Understanding and managing the genetic diversity of Noug ( <i>Guizotia abyssinica</i> ) for its improvement	12	<b>FAO</b>	
Subtotal	25	Expert Consultation: Planning and execution of an e-learning course on pre-breeding	3
<b>CIMMYT</b>		Participation in the advocacy platform for the CIARD	121
Technical support for uploading on SGRP Knowledge Bank Portal information materials related to crop best practices including procedures and guidelines for the safe movement of germplasm	36	Support of the development of a global information system on germplasm	53
<b>CIRAD</b>		Capacity building programme on the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) and its Multilateral System of Access and Benefit-sharing (MLS) in particular	103
Structural, functional and comparative annotation platform dedicated to plants' and their bioaggressors' genomes	1	Capacity building programme on the implementation of the International Treaty on Plant Genetic Resources for Food and Agriculture (IT-PGRFA) and its Multilateral System of Access and Benefit-sharing (MLS) in particular - Additional grant	67
<b>CTA</b>		Expert Consultation on Climate Change and Biodiversity for Food and Agriculture	83
Biodiversity and Sustainable Diets: "Against Hunger" International Scientific Symposium, held in FAO 3-5 November 2010	22	Addressing the role of biodiversity for food and agriculture in feeding the world and in light of global changes	105
Participatory Co-publishing contract for a manual on In situ conservation of crop wild relatives (English and French versions)	30	Organization of the Expert Consultation and Production of 'Draft Updated Genebank Standards'	30
Subtotal	52	Support for regional workshops on the preparation of Country Reports for the State of the World's Forest Genetic Resources	80
<b>European Commission</b>		Exploring the role of biodiversity for food and agriculture and sustainable agricultural intensification in feeding the world and in light of global changes - an expert consultation	72
Conserving and promoting the use of resources of commodity crops	1095	Addressing the role of biodiversity for food and agriculture in feeding the world and in light of global changes	59
Conservation and sustainable use of the forest and other wild species	457	Africa Consultation for the Update of the Global Plan of Action on the Conservation and Sustainable Use of PGRFA, 2-3 June 2010, Nairobi, Kenya	74
Open Access Infrastructure for Research in Europe	12	Subtotal	850
Building human and institutional capacity for enhancing the conservation and use of neglected and underutilized species of crops in West Africa, Eastern and Southern Africa	37		
Enabling Collective Action on Genetic Resources across the CGIAR Centres: Support for the System-wide Genetic Resources Programme (SGRP)	1341		
Forest ecosystem genomics research: Supporting Transatlantic Cooperation	101		
Establishment of a European Information System on Forest Genetic Resources (EUFGIS)	219		
EvoTREE network of excellence	215		
Subtotal	3477		

# Restricted grants 2010

<b>Finland</b>		ECPGR: Regeneration and safety duplication of regionally prioritized crop collections	59
Associate Expert—Forestry in APO	83	Subtotal	1197
<b>FONTAGRO</b>		<b>GRDC</b>	
Plantain technological innovations in production, processing and marketing: Improving the quality of life in rural communities in four Latin American and Caribbean countries	42	Vavilov-Frankel fellowships	20
<b>Gates Foundation</b>		<b>GTZ / BMZ</b>	
Agricultural Geospatial Information Leveraging Environment (AGILE)	348	Post-doc project: Assessing the contribution of diversified <i>Musa</i> genetic resources to poverty reduction, environmental sustainability and gender equality in rural communities	83
The effects of market integration on the nutritional contributions of traditional foods to the wellbeing of the rural poor in Africa	176	Publication of "Gene flow between Crops and their Wild Relatives in Centres of Crop Origin and Diversity"	4
Subtotal	524	Unraveling the potential of neglected crop diversity for high-value product differentiation and income generation to benefit poor farmers: The case of chili pepper in its centre of origin	430
<b>Global Crop Diversity Trust</b>		Improving small farm production and marketing of bananas under trees: Resource partitioning, living soils, cultivar choice and marketing strategies	453
Regeneration and safety duplication of regionally prioritized crop collections: REDARFIT	0	Subtotal	970
Regeneration of accessions in the international coconut genebank for Africa and the Indian Ocean	9	<b>ICARDA</b>	
Award Scheme for Enhancing the Value of Crop Diversity: Assessment of East African highland banana (AAA) and plantain (AAB) cultivars in Asia for resistance to <i>Fusarium oxysporum</i> f. sp. <i>cubense</i> (Foc) tropical race (TR) 4	8	<i>Musa</i> crop register activity	26
Validation of a coconut embryo culture protocol for the international exchange of germplasm	179	<b>IDRC</b>	
Development of a Global Strategy for the Ex Situ Conservation of pearl millet and finger millet and their Wild Relatives	10	Managing agriculture for better nutrition and health, improved livelihoods and more sustainable production system in SSA	94
Facilitating access to phenotypic data on the international in-trust collection of wheat and maize held at CIMMYT	18	<b>IFAD</b>	
The long-term funding of Ex Situ collections of germplasm held by Bioversity International	199	Programme for strengthening the income opportunities and nutritional security of the rural poor through neglected and underutilized species (NUS II)	263
Conserving banana diversity for use in perpetuity	179	Programme for Impact Evaluation Approaches for Agricultural Research	173
Development & refinement of cryopreservation protocols for the long-term conservation of vegetatively-propagated crops	38	La Settimana della Biodiversità: raising awareness of the value of the conservation and use of agricultural biodiversity	200
<b>GRENEWCA</b>	27	Technical support to IFAD's technical advisory division - sixth and seventh contract	86
ALIS - Global system information exchange for the conservation and use of plant genetic resources for food and agriculture	471	Agricultural Biodiversity - the foundation of our future	42
		Subtotal	764
		<b>IFAR</b>	
		2010 Fellowship - Uganda "Understanding <i>Pratylenchus goodeyi</i> variability for improving banana nematode management in east African highlands"	11



2010 Fellowship - Thailand "Development of molecular assays for tracing the wild ancestors of edible bananas and plantains"	11	Enhancing Farmers' Documentation of Traditional Knowledge (TK) of Rare Tropical Fruit Species Diversity for Enhanced Use in Malaysia	91
2010 Fellowship - Ethiopia "Addressing drought and stem rust resistance of Ethiopian tetraploid Wheat Landrace Populations using phenotypical Markers"	8	Subtotal	48
Subtotal	30	<b>McKnight Foundation</b>	
<b>IRRI</b>		Assessing the Success of On-Farm Conservation Projects in Delivering Conservation and Livelihood Outcomes: Identifying Best Practices and Decision Support Tools	41
Reducing and managing the loss of genetic integrity of conserved germplasm	18	Strengthening partnerships along value chains to manage <i>Xanthomonas</i> wilt ( <i>Xanthomonas campestris</i> pv <i>musacearum</i> ) of bananas in East and Horn of Africa	98
<b>Italy</b>		Subtotal	139
Associate Expert—Institutional Learning and Change	50	<b>Multi-Donors to "CacaoNet"</b>	
Associate Expert—2010 campaign	103	Support to "CacaoNet" expenditure	0
Subtotal	153	<b>Multi-Donors to "Cocoa of Excellence"</b>	
<b>Japan</b>		Cocoa of Excellence Private Sector Co-Financing	16
JIRCAS Fellowships - Characterization and Evaluation of the genetic diversity of neglected and underutilized crops in Malaysia	16	<b>Multi-Donors to CAS-IP</b>	
JIRCAS Fellowships - Assessment of farmers' agrobiodiversity management in Kenya: the cropping strategy in Kitui district in Eastern Kenya (A)	3	Consultancy services for Inter-Centre collaboration	73
JIRCAS Fellowships - Assessment of farmers' agrobiodiversity management in Kenya: the cropping strategy in Kitui district in Eastern Kenya (B)	3	<b>Multi-Donors to CGIAR-ICT/KM Coordination</b>	
Community plant genetic resources use and conservation in East Africa	147	Chief Information Officer expenditure	300
Subtotal	169	<b>Netherlands</b>	
<b>Korea, Republic of</b>		Associate Expert - Economic and social aspects of agrobiodiversity	87
Associate Scientist	120	Associate Expert - Assessing the potential contribution of banana-based production systems to improve nutrition	84
Associate Scientist—operational fund	28	Associate Expert—Economic and social Expert - Assessing the potential contribution of banana-based production systems to improve nutrition	90
Documentation of useful plant genetic resources in Asia-Pacific-Oceania region	40	Associate Expert - Platform for agricultural biodiversity research	99
Subtotal	188	Associate Expert - Nutrition in West Africa	68
<b>LIBIRD</b>		Associate Expert - Socio-economics	62
Promoting new rice and legume varieties from client-oriented breeding	7	Associate Expert - Enterprise and Value Chain Strengthening to Improve the Livelihoods of Small-scale Banana Farmers in Eastern and Central Africa	18
<b>Luxembourg</b>		Associate Expert - Underutilized Crop Species	51
Conservation, characterization and evaluation for nutrition and health of vegetative propagated crop collections at the Vavilov Institute	95	Associate Expert - Conservation and sustainable use of cultivated and wild tropical fruit diversity: promoting sustainable livelihoods, food security and ecosystem health	85
<b>Malaysia</b>			
Enhancing sustainable forest management and conservation strategies through genetic level research using <i>Shorea leprosula</i> and <i>S. Parvifolia</i> as model species	17		

# Restricted grants 2010

Innovating for sustainable poverty reduction	469	<b>Syngenta</b>	
Central Advisory Service on Intellectual Property - CAS-IP	1078	PACS Programme: Agrobiodiversity Conservation Services	45
Subtotal	2191	<b>Uganda</b>	
<b>Nordgen</b>		Novel approaches to the improvement of banana production in Eastern Africa: the application of biotechnological methodologies	474
PhD student	2		
<b>NZAID</b>		<b>UK Fundraising Initiative</b>	
Pacific Agricultural Plant Genetic Resources Network (Papgren)—Phase II	7	Matching seeds for needs: Innovative research using germplasm variation for adapting to climate change and improving the livelihoods of poor farmers in Papua New Guinea (PNG): Phase 1	93
<b>Peru</b>		<b>UNEP-GEF</b>	
Development of Andean grain crops with potential to ensuring people's nutrition and poverty alleviation	46	<i>In situ</i> conservation of crop wild relatives through enhanced information management and field application	107
Enhancing the competitiveness of Peruvian cocoa via the identification and commercialisation of fine and diverse flavour quality	44	Conservation and use of crop genetic diversity to control pests and diseases—Phase 1	1004
Policies that promote the use of Peruvian agrobiodiversity and local technological innovation, with a base in genetic resources, to overcome poverty, malnutrition and food insecurity in Peru	34	Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Human Nutrition and Wellbeing – Project Preparation Grant	216
Subtotal	124	Agricultural Biodiversity Conservation and Man and Biosphere Reserves in Cuba: Bridging Managed and Natural Landscapes	58
<b>Pioneer</b>		Small Scale Funding Agreement for PPG-Sri Lanka	37
Vavilov-Frankel Fellowship	10	<i>In situ</i> conservation of agricultural biodiversity (horticultural crops and wild fruit species) in Central Asia	771
<b>Portugal</b>		Conservation and Sustainable Use of Cultivated and Wild Tropical Fruit Diversity: Promoting Sustainable Livelihoods, Food Security and Ecosystem Services	354
Conservation strategies and the role of forest genetic resources in Mozambique	28	Subtotal	2547
<b>SDC</b>		<b>USDA</b>	
Strengthening the scientific basis of <i>in situ</i> conservation of agricultural biodiversity - Phase V	7	Collaboration with Bioversity International to support research and conservation of crop genetic resources	7
<i>In Situ</i> Conservation of Agricultural Biodiversity in Agriculture and Wild Ecosystems: Publication, Layout, Printing and Distribution	67	Support to CacaoNet and ingenic activities	0
CGIAR System-wide efforts to develop technical inputs to the governing body of the international treaty concerning the sustainable use of PGR under Article 6 of the Tr	20	Subtotal	7
Subtotal	94	<b>Wageningen University</b>	
<b>SIDA</b>		Feasibility study for the pesticide reduction plan for banana	1
ASARECA technical backstopping to EAPGREN	4	Global study for community empowerment for <i>in situ</i> conservation of plant genetic resources for food and agriculture	6
<b>Spain</b>		Subtotal	7
Strengthening regional collaboration in conservation and sustainable use of forest genetic resources in Latin America and sub-Saharan Africa	126	<b>WHAO</b>	
Institutional strengthening for sustainable resource use in the Amazon region	55	Food Composition Data Compilation	34
Subtotal	181		

<b>World Bank</b>			
CGIAR genetic resources policy committee	61		
Central Advisory Services on Intellectual Property (CAS-IP)	100		
International Year of Biodiversity - Diversity for Life Campaign Activities in Kenya	15		
Development marketplace - Adaptation to climate change: Innovative tools to match seeds to the needs of women farmers	68		
Collective action for the rehabilitation of global public goods in the CGIAR genetic resources system - Phase II (GPG 2)	678		
Development marketplace - Modern genomics methods benefiting small farmers' value chain	27		
System-wide and ecoregional program	200		
Subtotal	1149		
<b>Subtotal Temporary Restricted Grants</b>	<b>21123</b>		
<b>CCAFS - Challenge Program</b>			
Establishment of a farmer-based experimentation network in the Indo-Gangetic Plains (IGP) region: Pilot project for on-farm participatory climate change adaptation and visualization	1		
<b>Generation - Challenge Program</b>			
<i>Musa</i> genome frame-map construction and connection with the rice sequence	3		
Establishing a Genetic Resource Support Service (GRSS) for the plant breeding community	1		
Enhancement and implementation of the Crop Ontology for data integration and data interoperability	1		
Managing the Generation Challenge Programme in a Post-International Treaty World	14		
Development of data standards and community of practice enabling the capture of and access to GCP quality data sets	91		
Development of an integrated GCP informatics platform	0		
Subtotal	110		
<b>HarvestPlus - Challenge Program</b>			
Addressing micronutrient deficiencies in Sub-Saharan African through <i>Musa</i> -based foods (amendment 5)	13		
Addressing micronutrient deficiencies in Sub-Saharan Africa through <i>Musa</i> -based foods, Phase II	65		
Subtotal	78		
<b>Sub-Saharan Africa - Challenge Program</b>			
Improving human nutrition and income through integrated agricultural research on production and marketing of vegetables in Malawi and Mozambique		486	
<b>Subtotal Challenge Programs</b>		<b>675</b>	
<b>Total Restricted Grants</b>		<b>21 534</b>	



# Selected publications

- Addis T, Azerefegne F, Alemu T, Lemawork S, Tadesse E, Gemu M, Blomme G. 2010. Biology, geographical distribution, prevention and control of the Enset root mealybug, *Cataenococcus ensete* (Homoptera: Pseudococcidae) in Ethiopia. In: Tripathi L. (editor). *Bananas, plantains and enset I. Tree and Forestry Science and Biotechnology*, 4 (Special Issue 1): 39–46.
- Addis T, Turyagyenda LF, Alemu T, Karamura E, Blomme G. 2010. Garden tool transmission of *Xanthomonas campestris* pv. *musacearum* on banana (*Musa* spp.) and enset in Ethiopia. *Acta Horticulturae*, 879: 367–372.
- Aisyafaznim SA, Rahman S, Mohamed Z, Othman RY, Swennen R, Panis B, De Waele D, Remy S, Carpentier S. 2010. In planta PCR-based detection of early infection of plant-parasitic nematodes in the roots: a step towards the understanding of infection and plant defence. *European Journal of Plant Pathology*, 128: 343–351.
- Akinyemi SOS, Staver C, Aiyelaagbe IOO, Kintomo AA, Babalola SO. 2010. Perspectives of small-scale *Musa* processing firms in Nigeria. *Acta Horticulturae*, 879: 257–263.
- Anderson CL, Lipper L, Dalton TJ, Smale M, Hellin J, Hodgkin T, Almekinders C, Audi P, Bellon MR, Cavatassi R, Diakite L, Jones R, King O, Keleman A, Meijer M, Osborn T, Nagarajan L, Paz A, Rodriguez M, Sidibe A. 2010. Project methodology: Using markets to promote the sustainable utilization of crop genetic resources. In: Lipper L, Anderson CL, Dalton TJ. (editors). *Seed trade in rural markets: Implications for crop diversity and agricultural development*. Earthscan, UK. pp. 32–50.
- Andersson M, de Vicente C. (editors). 2010. *Gene flow between crops and their wild relatives*. John Hopkins University Press, USA. 584 p.
- Asrat S, Yesuf M, Carlsson F, Wale E. 2010. Farmers' preferences for crop variety traits. Lessons for on-farm conservation and technology adoption. *Ecological Economics*, 69(12): 2394–2401.
- Babiker AZ, Dulloo ME, El Balla MAM, Ibrahim ET. 2010. Effects of low cost drying methods on seed quality of *Sorghum bicolor* (L.) Moench. *African Journal of Plant Science*, 4(9): 339–345.
- Bajracharya J, Rana RB, Gauchan D, Sthapit BR, Jarvis DI, Witcombe JR. 2010. Rice landrace diversity in Nepal. Socio-economic and ecological factors determining rice landrace diversity in three agro-ecozones of Nepal based on farm surveys. *Genetic Resources and Crop Evolution*, 57(7): 1013–1022.
- Bala Ravi S, Hrudeek TK, Kishore Kumar AT, Prabhakaran TR, Bhag Mal, Padulosi S. 2010. Mobilizing neglected and underutilized crops to strengthen food security and alleviate poverty in India. *Indian Journal of Plant Genetic Resources* 23(1): 110–116.
- Barba M, Van den Bergh I, Belisario A, Beed F. 2010. The need for culture collections to support plant pathogen diagnostic networks. *Research in Microbiology*, 161(6): 472–479.
- Baurens FC, Bocs S, Rouard M, Matsumoto T, Miller M, Rodier-Goud M, MBeguie-A-MBeguie D, Yahiaoui, N. 2010. Mechanisms of haplotype divergence at the RGA08 nucleotide-binding leucine-rich repeat gene locus in wild banana (*Musa balbisiana*). *BMC Plant Biology*, 10(1): 149
- Bellon M, Keleman A, Hellin J. 2010. Maize diversity and gender: research from Mexico. *Gender & Development*, 18(3): 427–437.
- Bellon MR, Anderson CL, Lipper L, Dalton TJ, Keleman A, Grum M. 2010. Synthesis: Markets, seed systems and crop diversity. In: Lipper L, Anderson CL, Dalton TJ (editors). *Seed trade in rural markets: Implications for crop diversity and agricultural development*. Earthscan, UK. pp. 189–208.
- Bioversity International; All-India Coordinated Research Project on Small Millets (AICRP-Small Millets); IITA; ICRISAT; National Bureau of Plant Genetic Resources (NBPGR). 2010. Key access and utilization descriptors for finger millet genetic resources. Bioversity International, Italy. 4 p.
- Bioversity International; CIP. 2010. Key access and utilization descriptors for sweet potato genetic resources. Bioversity International, Italy. 11 p.
- Bioversity International; ICARDA; ICRISAT; Indian Agricultural Research Institute (IARI). 2010. Key access and utilization descriptors for chickpea genetic resources. Bioversity International, Italy. 6 p.
- Bioversity International; ICARDA; National Bureau of Plant Genetic Resources (NBPGR). 2010. Key access and utilization descriptors for lentil genetic resources. Bioversity International, Italy. 5 p.
- Bioversity International; ICRISAT; Indian Council of Agricultural Research (ICAR). 2010. Key access and utilization descriptors for pigeonpea genetic resources. Bioversity International, Italy. 4 p.
- Bioversity International; ICRISAT; United Sorghum Checkoff Program. 2010. Key access and utilization descriptors for sorghum genetic resources. Bioversity International, Italy. 6 p.
- Bioversity International; ICRISAT; United States Department of Agriculture (USDA); National Plant Germplasm System (NPGS); All-India Coordinated Research Project (AICRP) on Pearl Millet. 2010. Key access and utilization descriptors for pearl millet genetic resources. Bioversity International, Italy. 4 p.
- Bioversity International; National Bureau of Plant Genetic Resources (NBPGR); IITA. 2010. Key access and utilization descriptors for cowpea genetic resources. Bioversity International, Italy. 5 p.
- Bioversity International; The Christensen Fund. 2010. Descriptores del conocimiento que los agricultores tienen de las plantas. Bioversity International, Italy. 24 p.
- Bonham CA, Dulloo E, Mathur P, Brahmi P, Tyagi V, Tyagi RK, Upadhyaya H. 2010. Plant genetic resources and germplasm use in India. *Asian Biotechnology and Development Review*, 12(3): 17–34.
- Cabrera JA, Pocasangre LE, Pattison AB, Sikora RA. 2010. Terbufos biodegradability and efficacy against *Radopholus similis* in soils from banana cultivation having different histories of nematicide use, and the effect of terbufos on plant growth of in vitro-propagated *Musa*

- AAA cv. Grande Naine. *International Journal of Pest Management*, 56(1): 61–67.
- Carpentier S, Vertommen A, Swennen R, Witters E, Fortes C, Souza MT Jr, Panis B. 2010. Sugar-mediated acclimation: the importance of sucrose metabolism in meristems. *Journal of Proteome Research*, 9: 5038–5046
  - Cote F, Tomekpe K, Staver C, Depigny S, Lescot T, Markham R. 2010. Agro-ecological intensification in banana and plantain (*Musa* spp.): An approach to develop more sustainable cropping systems for both smallholder farmers and large-scale commercial producers. *Acta Horticulturæ*, 879: 457–463.
  - Dawson IK, Vinceti B, Weber JC, Neufeldt H, Russell J, Lengkeek AG, Kalinganire A, Kindt R, Lilleso JB, Roshetko JM, Jamnadass, R. 2011. Climate change and tree genetic resource management: maintaining and enhancing the productivity and value of smallholder tropical agroforestry landscapes. A review. *Agroforestry Systems*, 81(1): 67–78. [Pre-published online in 2010]
  - de Boef WS, Dempewolf H, Byakweli JM, Engels JMM. 2010. Integrating genetic resource conservation and sustainable development into strategies to increase the robustness of seed systems. *Journal of Sustainable Agriculture*, 34(5): 504–531.
  - De Langhe E, Hribova E, Carpentier S, Dolezel J, Swennen R. 2010. Did backcrossing contribute to the origin of hybrid edible bananas? *Annals of Botany*, 106(6): 849–857.
  - Defries R, Denning G, Fanzo J, Jackson LE, Leemans R, Lehmann J, Milder JC, Naeem S, Nziguheba G, Palm CA, Pingali L, Reganold JP, Richter DD, Scherr SJ, Sircely J, Sullivan C, Tomich TP, Sanchez PA. 2010. Monitoring the world's agriculture. *Nature*, 466: 558–560.
  - Delgado F, Ribeiro S, Alves A, Bettencourt E, Dias S. 2010. Morphological, ecological and genetic variability of *Lavandula luisieri* (Rozeira) Rivas-Martinez in central eastern Portugal. *Plant Genetic Resources: Characterization and Utilization*, 8(1): 82–90.
  - Dempewolf H, Kane NC, Ostevik KL, Geleta M, Barker MS, Lai Z, Stewart ML, Bekele E, Engels JMM, Cronk QCB, Rieseberg LH. 2011. Establishing genomic tools and resources for *Guizotia abyssinica* (L.f.) Cass. – the development of a library of expressed sequence tags, microsatellite loci, and the sequencing of its chloroplast genome. *Molecular Ecology Resources*, 10(6): 1048–1058. [Pre-published online in 2010]
  - Dizon TO, Pinili MS, de la Cruz FS, Damasco OP, Van den Bergh I, De Waele D. 2010. Response of Philippine banana (*Musa* spp.) cultivars to *Radopholus similis* (Thorne) and *Meloidogyne incognita* Chitwood under greenhouse conditions. *Philippine Journal of Crop Science*, 35(1): 35–51.
  - Dornez E, Croes E, Gebruers K, Carpentier S, Swennen R, Laukens K, Witters E, Urban M, Delcour JA, Courtin CM. 2010. 2-D DIGE reveals changes in wheat xylanase inhibitor protein families due to *Fusarium graminearum* Delta Tri5 infection and grain development. *Proteomics* 10(12): 2303–2319.
  - Dowiya NB, Blomme G, Dheda DB, Rweyemamu C, Velly D, Vigheri N, Milambo A, Eden-Green S. 2010. The alarming spread of banana Xanthomonas wilt in eastern Democratic Republic of Congo and its impact on food security and income. In: Tripathi, L. (editor). *Bananas, plantains and enset. II. Tree and Forestry Science and Biotechnology*, 4 (Special Issue 2):56–59.
  - Drucker A. 2010. Where's the beef? The economics of AnGR conservation and its influence on policy design and implementation. *Animal Genetic Resources*, 47: 85–90.
  - Dubois T, Hauser S, Staver C, Coyne D. (editors), 2010. Harnessing international partnerships to increase research impact. Proceedings of the International Conference on Banana and Plantain in Africa. Mombasa, Kenya, 5–9 October 2008. *Acta Horticulturæ*. 879. (2 vols.). ISHS, Belgium. 864 p.
  - Dulloo E, Jarvis D, Thormann I, Scheldeman X, Salcedo J, Hunter D, Hodgkin T. 2010. The state of *in situ* management. In: *The second report on the State of the World's Plant Genetic Resources for Food and Agriculture*. FAO, Italy. pp. 31–51.
  - Dulloo ME, Hunter D, Borelli T. 2010. *Ex situ* and *in situ* conservation of agricultural biodiversity: major advances and research needs. *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 38(2): 123–135.
  - Dzikiti S, Verreynne JS, Stuckens J, Strever A, Verstraeten WW, Swennen R, Coppin P. 2010. Determining the water status of Satsuma mandarin trees [*Citrus unshiu* Marcovitch] using spectral indices and by combining hyperspectral and physiological data. *Agricultural and Forest Meteorology*, 150(3): 369–379.
  - Dzomeku BM, Staver C, Aflakpui GK, Sanogo D, Garming H, Ankomah AA, Darkey SK. 2010. Evaluation of the dissemination of new banana (*Musa* spp.) technologies in Central Ghana: The role of technology characteristics. *Acta Horticulturæ*, 879: 735–740.
  - Ekue MRM, Sinsin B, Eyog-Matig O, Finkeldey R. 2010. Uses, traditional management, perception of variation and preferences in ackee (*Blighia sapida* KD Koenig) fruit traits in Benin: implications for domestication and conservation. *Journal of Ethnobiology and Ethnomedicine*, 6: Art. 12. 14 p. [Online Journal].
  - Engels JMM, Dempewolf H, Henson-Apollonio V. 2011. Ethical considerations in agro-biodiversity research, collecting, and use. *Journal of Agricultural and Environmental Ethics*, 24(2): 107–126. [Pre-published online in 2010]
  - Eyzaguirre PB, Hunter D, Matthews PJ, Rao RV. 2010. Ethnobotany and global diversity of taro. In: Rao VR, Matthews PJ, Eyzaguirre PB, Hunter D. (editors). *The Global Diversity of Taro: Ethnobotany and Conservation*. Bioversity International, Italy. pp. 1–5.
  - Eyzaguirre PB, Xixiang Li, Dewei Zhu, Yongping Y, Jianchu Xu, Mingde Z. 2010. Ethnobotany and genetic diversity of taro in Yunnan, China – analyses of diversity using multiple techniques. In: Rao VR, Matthews PJ, Eyzaguirre PB, Hunter D. (editors). *The Global Diversity of Taro: Ethnobotany and Conservation*. Bioversity International, Italy. pp. 98–120.

# Selected publications

- Frison C, Dedeurwaerdere T, Halewood M. 2010. Intellectual property and facilitated access to genetic resources under the International Treaty on Plant Genetic Resources for Food and Agriculture. *European Intellectual Property Review*, 32(1): 1–8.
- Fukushima T, Morimoto Y, Maundu P, Kahindi B, Fondo J. 2010. Local preference of indigenous fruit trees in Coast Province, Kenya. *African Journal of Environmental Science and Technology*, 4(12): 872–885.
- Galluzzi G, Eyzaguirre P, Negri, V. 2010. Home gardens: neglected hotspots of agro-biodiversity and cultural diversity. *Biodiversity and Conservation* 19(13): 3635–3654.
- Gotor E, Caracciolo F, Watts J. 2010. The perceived impact of the In-Trust Agreements on CGIAR germplasm availability: an assessment of Bioversity International's institutional activities. *World Development*, 38(10): 1486–1493.
- Gotor E, Caracciolo, F. 2010. An empirical assessment of the effects of the 1994 In Trust agreements on IRRI germplasm acquisition and distribution. *International Journal of the Commons* 4(1): 437–451.
- Gotor E, Irungu C. 2010. The impact of Bioversity International's African Leafy Vegetable Programme in Kenya. *Impact Assessment and Project Appraisal*, 28(1): 41–55.
- Gotor E, Tsigas EM. 2011. The impact of the EU sugar trade reform on poor households in developing countries: a general equilibrium analysis. *Journal of Policy Modeling*, In press. [Pre-published online in 2010]
- Guariguata MR, Garcia-Fernandez C, Sheil D, Nasi R, Herrero-Jauregui C, Cronkleton P, Ingram V. 2010. Compatibility of timber and non-timber forest product management in natural tropical forests: perspectives, challenges, and opportunities. *Forest Ecology and Management*, 259: 237–245.
- Gyawali S, Sthapit BR, Bhandari B, Bajracharya J, Shrestha PK, Upadhyay MP, Jarvis DI. 2010. Participatory crop improvement and formal release of Jethobudho rice landrace in Nepal. *Euphytica*, 176(1): 59–78.
- Halewood M. 2010. Governing the management and use of pooled microbial genetic resources. Lessons from the global crop commons. *International Journal of the Commons*, 4(1): 404–436.
- Haruntyunyan M, Dooloo ME, Yeritsyan N, Danielyan A. 2010. Red List assessment of nine *Aegilops* species in Armenia. *Genetic Resources and Crop Evolution*, 57(8): 1177–1189.
- Hellin J, Keleman A, Bellon MR, van Heerwaarden J. 2010. Mexico, maize and Chiapas case study. In: Lipper L, Anderson CL, Dalton TJ. (editors). *Seed trade in rural markets: Implications for crop diversity and agricultural development*. Earthscan, UK. pp. 153–188
- Hribova E, Neumann P, Matsumoto T, Roux N, Macas J, Dolezel J. 2010. Repetitive part of the banana (*Musa acuminata*) genome investigated by low-depth 454 sequencing. *BMC Plant Biology*, 10: Art. no. 204. [Online Journal]
- Hunter D, Iosefa T, Singh D, Okpul T, Fonoti P, Delp C. 2010. Improving taro production in the South Pacific through breeding and selection. In: Rao VR, Matthews PJ, Eyzaguirre PB, Hunter D. (editors). *The Global Diversity of Taro: Ethnobotany and Conservation*. Bioversity International, Italy. pp. 168–184.
- Hunter D, Mace ES, Mathur PN, Godwin ID, Taylor MB, DeLacy IH, Singh D. 2010. Development of a regional core collection (Oceania) for taro, *Colocasia esculenta* (L.) Schott, based on molecular and phenotypic characterization. In: Rao VR, Matthews PJ, Eyzaguirre PB, Hunter D. (editors). *The Global Diversity of Taro: Ethnobotany and Conservation*. Bioversity International, Italy. pp. 185–201.
- Jorge MA, Claessens G, Hanson J, Dooloo ME, Goldberg E, Thormann I, Alemayehu S, Gacheru E, Amri A, Benson E, Dumet D, Roux N, Rudebjer P, Sackville-Hamilton R. 2010. Knowledge sharing on best practices for managing crop genebanks. *Agriculture Information Worldwide*, 3(2): 101–106.
- Karamura D, Karamura E, Tushemereirwe W, Rubaihayo PR, Markham R. 2010. Somatic mutations and their implications to the conservation strategies of the East African highland bananas (*Musa* spp.). *Acta Horticulturae*, 879: 615–621.
- Karamura E, Kayobyo G, Tushemereirwe W, Benin S, Blomme G, Eden Green S, Markham R. 2010. Assessing the impacts of banana bacterial wilt disease on banana (*Musa* spp.) productivity and livelihoods of Ugandan farm households. *Acta Horticulturae*, 879: 749–755.
- Katayama Y, Ofosu-Anim J, Morimoto Y, Mohammed SA. 2010. Strategies and challenges for research and development of underutilized plant species in Africa. *Agriculture and Horticulture*, 85(11): 1124–1128.
- Khoury C, Laliberte B, Guarino L. 2010. Trends in ex situ conservation of plant genetic resources. *Genetic Resources and Crop Evolution* 57(4): 625–639.
- Kim HH, Popova EV, Lee JY, Park SU, Lee SC, Engelmann F. 2010. Cryopreservation of hairy roots of *Rubia akane* (Nakai) using a droplet-vitrification procedure. *CryoLetters*, 31(6): 473–484.
- Larwanou M, Oumarou I, Snook L, Danguimbo I, Eyog-Matig O. 2010. Pratiques sylvicoles et culturelles dans les parcs agroforestiers suivant un gradient pluviométrique nordsud dans la région de Maradi au Niger. *Tropicultura*, 28(2): 115–122.
- Lawrence T, Sette C. 2010. Managing complex multi-partner projects: Report of a peer-assist process. *ILAC Meeting Report Series*, No. 2. 17 p.
- Lefranc LM, Lescot T, Staver C, Kwa M, Michel I, Nkpanang I, Temple L. 2010. Macropopagation as an innovative technology: Lessons and observations from projects in Cameroon. *Acta Horticulturae*, 879: 727–733.
- Lilja N, Kristjanson P, Watts J. 2010. Rethinking impact: understanding the complexity of poverty and change – overview. *Development in Practice*, 20(8): 917–932.



- Maggioni L, van Hintum T, Begemann F. 2010. The European *ex situ* PGR information landscape. In: Maurer L, Tochtermann K. (editors). *Information and Communication Technologies for Biodiversity Conservation and Agriculture*. Shaker Verlag, Germany. pp. 155–171.
- Maggioni L, von Bothmer R, Branca F. 2010. Origin and domestication of cole crops (*Brassica oleracea* L): linguistic and literary considerations. *Economic Botany*, 64(2): 109–123.
- Marco-Medina A, Casas JL, Swennen R, Panis B. 2010. Cryopreservation of *Thymus moroderi* by droplet vitrification. *CryoLetters*, 31(1): 14–23.
- Mercer KL, Perales HR. 2010. Evolutionary response of landraces to climate change in centers of crop diversity. *Evolutionary Applications*, 3(5–6): 480–493.
- Mgenzi SR, Mshaghuley IM, Staver C, Nkuba JM. 2010. Banana (*Musa* spp.) processing businesses: support environment and role in poverty reduction in rural Tanzania. *Acta Horticulturae*, 879: 249–255.
- Mobambo P, Staver C, Hauser S, Dheda B, Vangu G. 2010. An innovation capacity analysis to identify strategies for improving plantain and banana (*Musa* spp.) productivity and value addition in the Democratic Republic of Congo. *Acta Horticulturae*, 879: 821–827.
- Mobambo PK, Gauhl F, Pasberg-Gauhl C, Swennen R, Staver C. 2010. Factors influencing the development of black streak disease and the resulting yield loss in plantain in the humid forests of West and Central Africa. In: Tripathi L. (editor). *Bananas, plantains and enset I. Tree and Forestry Science and Biotechnology*, 4(Special Issue 1): 47–51.
- Moore G. 2010. Multilateral and national regulatory regimes for agrobiodiversity. In: Lockie S, Carpenter D. (editors). *Agriculture, biodiversity and markets: Livelihoods and agroecology in comparative perspective*. Earthscan, UK. pp. 47–60.
- Morimoto Y, Maundu P, Katayama Y. 2010. Strategies and challenges for research and development of underutilized plant species in Africa. *Agriculture and Horticulture*, 85(10): 1062–1066.
- Morimoto Y, Maundu P, Tumbo D, Eyzaguirre PB. 2010. How farmers in Kitui use wild and agricultural ecosystems to meet their nutritional needs. In: Bélair C, Ichikawa K, Wong BYL, Mulongoy KJ. (editors). *Sustainable use of biological diversity in socio-ecological production landscapes. Background to the 'Satoyama Initiative for the benefit of biodiversity and human well-being'*. CBD Technical Series. 52: 67–72.
- Ntamwira J, Nzawe DB, Katunga D, Van Asten P, Blomme G. 2010. The effect of application of organic matter during planting on growth of an East African highland cooking banana grown on two contrasting soils in South Kivu, Eastern DR-Congo. In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 15–16.
- Ozudogru EA, Capuana M, Kaya E, Panis B, Lambardi M. 2010. Cryopreservation of *Fraxinus excelsior* L. embryogenic callus by one-step freezing and slow cooling techniques. *CryoLetters*, 31(1): 63–75.
- Padulosi S, Sthapit B, Bhag Mal. 2010. Role of on-farm/in situ conservation and underutilized crops in the wake of climate change. *Indian Journal of Plant Genetic Resources*, 23(2): 145–156.
- Raman H, Stodart BJ, Cavanagh C, Mackay M, Morell M, Milgate A, Martin P. 2010. Molecular diversity and genetic structure of modern and traditional landrace cultivars of wheat (*Triticum aestivum* L.). *Crop and Pasture Science*, 61: 222–229.
- Rao VR, Matthews PJ, Eyzaguirre PB, Hunter D. (editors). *The Global Diversity of Taro: Ethnobotany and Conservation*. Bioversity International, Italy. 202 p.
- Rosales FE, Alvarez JM, Vargas A. 2010. Guide pratique pour la production de bananes-plantain sous haute densité de plantation. Retours d'expériences d'Amérique latine et des Caraïbes. Bioversity International, Italy. 34 p.
- Rouard M, Guignon V, Aluome C, Laporte M, Droc G, Walde C, Zmasek CM, Perin C, Conte MG. 2011. GreenPhylDB v2.0: comparative and functional genomics in plants. *Nucleic Acids Research*, 39: D1095–D1102 (Suppl. 1). [Pre-published online in 2010]
- Salaj T, Matusikova I, Panis B, Swennen R, Salaj J. 2010. Recovery and characterisation of hybrid firs (*Abies alba* × *A. cephalonica* and *Abies alba* × *A. numidica*) embryogenic tissues after cryopreservation. *CryoLetters*, 31(3): 206–217.
- Sette C, Watts J. 2010. Group facilitation skills for participatory decision-making: Report of a follow-up outcome evaluation. *ILAC Working Paper*, no. 11. 21 p.
- Shanthakumar G, Bhag Mal, Padulosi S, Bala Ravi S. 2010. Participatory varietal selection: a case study on small millets in Karnataka. *Indian Journal of Plant Genetic Resources*, 23(1): 117–121.
- Shehabu M, Addis T, Mekonen S, De Waele D, Blomme G. 2010. Nematode infection predisposes banana to soil-borne *Xanthomonas campestris* pv *musacearum* transmission. In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 63–64.
- Shehabu M, Addis T, Turyagyenda LF, Alemu T, Mekonen S, Blomme G. 2010. The efficiency of air-drying pared corms of banana suckers in reducing the risk of soil-mediated *Xanthomonas* wilt infections in Ethiopia. In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 60–62.
- Shrestha R, Arnaud E, Mauleon R, Senger M. 2010. Multifunctional crop trait ontology for breeders' data: field book, annotation, data discovery and semantic enrichment of the literature. *AoB Plants* [Online]. See doi: 10.1093/aobpla/plq008.

# Selected publications

- Sikora RA, zum Felde A, Mendoza A, Menjivar R, Pocasangre L. 2010. *In planta* suppressiveness to plant nematodes and long-term root health stability through biological enhancement – Do we need a cocktail? *Acta Horticulturæ*, 879: 553–560.
- Srinivasarao C, Soni A, Dulloo ME, Naithani SC. 2010. Overcoming physiological dormancy in *Ceropegia odorata* seeds, an endangered rare species, with GA<sub>3</sub>, H<sub>2</sub>O<sub>2</sub> and KNO<sub>3</sub>. *Seed Science and Technology*, 38: 341–347.
- Ssekiwoko F, Turyagyenda LF, Mukasa H, Eden-Green S, Blomme G. 2010. Spread of *Xanthomonas campestris* pv. *musacearum* in banana (*Musa* spp.) plants following infection of the male inflorescence. *Acta Horticulturæ*, 879: 349–356.
- Staiger-Rivas S, Galie A, Hack B, Jorge MA, Meadu V, Tateossian F, Salokhe G, White N. 2010. Learning to share knowledge for global agricultural progress. *International Journal of Web Based Communities*, 6(2): 209–226.
- Staver C, Junkin R, Flores W, Gonzales I, Akinyemi SO, Ngho G, Banda D, Byabachwezi M, Narayana CK, Masdek N, Arganosa A. 2010. *Musa* processing businesses: Their contribution to rural development. *Acta Horticulturæ*, 879: 225–232.
- Staver C, Van den Bergh I, Karamura E, Blomme G, Lescot T. 2010. Targeting actions to improve the quality of farmer planting material in bananas and plantains – Building a national priority-setting framework. In: Tripathi L. (editor). *Bananas, plantains and enset I. Tree and Forestry Science and Biotechnology*, 4(Special Issue 1): 1–10.
- Stromberg M, Pascual U, Bellon M. 2010. Seed systems and farmers' seed choices: The case of maize in the Peruvian Amazon. *Human Ecology*, 38(4): 539–553.
- Stuckens J, Somers B, Albrigo GL, Dziki S, Verstraeten W, Swennen R, Verreyne S, Coppin, P. 2010. Off-nadir viewing for reducing spectral mixture issues in citrus orchards. *Photogrammetric Engineering and Remote Sensing*, 76(11): 1261–1274.
- Suarez RK, Sajise PE. 2010. Deforestation, swidden agriculture and Philippine biodiversity. *Philippine Science Letters*, 3(1): 91–99.
- Tadesse E, Azerefegne F, Alemu T, Addis T, Blomme G. 2010. Studies on the efficacy of some selected botanicals against Enset root mealybug (*Cataenococcus ensete* Williams and Matile-Ferrero (Homoptera: Pseudococcidae)) In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 91–94.
- Tadesse E, Azerefegne F, Alemu T, Blomme G, Addis T. 2010. The effect of insecticides against the root mealybug (*Cataenococcus ensete*) of *Ensete ventricosum* in Southern Ethiopia. In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 95–97.
- Temu BA, Rudebjør GP, Chakeredza S. 2010. Enhancing integrated approaches in agricultural learning systems using experiences from agroforestry. *Scientific Research and Essays*, 5(16): 2179–2185.
- Tetang JT, Kwa M, Temple L, Bikoi A, Njukwe E, Staver C, Ottou JF. 2010. Meeting the challenge of the plantain (*Musa* spp.) subsector economic restructuring in Cameroon. *Acta Horticulturæ*, 879: 829–835.
- Till BJ, Jankowicz-Cieslak J, Sagi L, Huynh OA, Utsushi H, Swennen R, Terauchi R, Mba, C. 2010. Discovery of nucleotide polymorphisms in the *Musa* gene pool by Ecotilling. *Theoretical and Applied Genetics*, 121(7): 1381–1389.
- Vertommen A, Panis B, Swennen R, Carpentier S. 2010. Evaluation of chloroform/methanol extraction to facilitate the study of membrane proteins of non-model plants. *Planta*, 231: 1113–1125.
- Vijayalakshmi D, Geetha K, Jayarame Gowda, Bala Ravi S, Padulosi S, Bhag Mal. 2010. Empowerment of women farmers through value addition on minor millets genetic resources: a case study in Karnataka. *Indian Journal of Plant Genetic Resources*, 23(1): 132–135.
- Walangululu MJ, Matara MR, Bahati L, Niyongere C, Lepoint P, Blomme G. 2010. Assessing the spread and seasonal influence of fruit peel disease and banana bunchy top disease in South Kivu, Eastern DR-Congo. In: Tripathi L. (editor). *Bananas, plantains and enset II. Tree and Forestry Science and Biotechnology*, 4(Special Issue 2): 98–104.
- Wale E, Drucker AG, Zander KK. (editors). 2010. The economics of managing crop diversity on-farm. Case studies from the genetic resources policy initiative. Earthscan, UK. 160 p.
- Wale E, Yalew A. 2010. On biodiversity impact assessment. The rationale, conceptual challenges and implications for future environmental impact assessment. *Impact Assessment and Project Appraisal*, 28(1): 3–13.
- Wale E. 2010. How do farmers allocate land for coffee trees? Implications for on-farm conservation and seed technology adoption in Ethiopia. *Journal of Sustainable Agriculture*, 34(3): 270–291.
- Yenagi NB, Handigol JA, Bala Ravi S, Bhag Mal, Padulosi S. 2010. Nutritional and technological advancements in the promotion of ethnic and novel foods using the genetic diversity of minor millets in India. *Indian Journal of Plant Genetic Resources*, 23(1): 82–86.

# Projects

## **Project F01: Enhancing the contribution of agricultural biodiversity to human wellbeing**

aims to enhance the use of agricultural and forest biodiversity to improve people's well-being, by demonstrating ways in which biodiversity can support nutritional and health benefits and by identifying new biodiversity-based income options for the rural and urban poor.

## **Project F02: Productivity, resilience and ecosystem services from community management of diversity in production systems**

is concerned with developing practices that support communities in their use of genetic diversity to maintain and improve productivity, resilience and resistance in production systems.

## **Project F03: Managing biodiversity to improve livelihoods in commodity crop-based systems**

focuses on enabling rural communities to better use coconut, cacao and *Musa* diversity to increase their incomes, food security, health and natural resource endowments.

## **Project F04: Conserving and promoting the use of genetic resources of commodity crops**

aims to promote the conservation, characterization, evaluation and effective use of the genetic diversity of coconut, cacao and *Musa*, three commodity crops of special importance to smallholders in developing countries. The project seeks to strengthen international

research capacity through networks and consortia, and facilitates consensus building through action-oriented platforms.

## **Project F05: Enhancing the *ex situ* conservation and use of genetic diversity**

aims to improve the *ex situ* conservation and use of agricultural biodiversity, including crop wild relatives, as a means of mitigating the impacts of global threats such as environmental degradation, water scarcity and climate change.

## **Project F06: Conservation and use of forest and other wild species**

aims to document the diversity within useful wild species, including wild relatives of crops; study and make known the benefits it confers; analyze the threats to its persistence; and provide knowledge, strategies, mechanisms and tools to facilitate its conservation and sustainable use.

## **Project F07: Biodiversity informatics**

aims to improve the management of, access to, and use of genetic resources information through standardized information gathering and management, facilitating information use, exchange and access, and capacity building.

## **Project F08: Policy and law**

contributes to genetic resources policy development at global, regional, national and CGIAR system-wide levels. The Project is the administrative home of the

CGIAR Central Advisory Service on Intellectual Property (CAS-IP) and provides the secretariat for the Genetic Resources Policy Committee (GRPC) of the CGIAR.

## **Project F09: Strengthening global systems for conservation and use of genetic resources**

contributes to the development of more effective global and regional collaboration on conservation and use of agricultural biodiversity. Through the Project, Bioversity discharges its responsibilities as convening Centre of the System-wide Genetic Resources Programme (SGRP) and, in partnership with FAO, provides support for the Global Crop Diversity Trust (GCDT). It also hosts the Platform for Agrobiodiversity Research (PAR).

## **Project F10: Status, trends and valuation of agrobiodiversity**

aims to assess the status, trends and values of agricultural biodiversity at the genetic level, to provide tools and mechanisms for long-term monitoring of genetic erosion and to evaluate the cost of agrobiodiversity loss, its drivers and strategies to counter them.



# Establishment agreement

**The international status of Bioversity is conferred under an Establishment Agreement which, by December 2010, had been signed by the Governments of:**

Algeria, Australia, Belgium, Benin, Bolivia, Brazil, Burkina Faso, Burundi, Cameroon, Chile, China, Congo, Costa Rica, Côte d'Ivoire, Cyprus, Cuba, Czech Republic, Denmark, Ecuador, Egypt, Ethiopia, Ghana, Greece, Guinea, Hungary, India, Indonesia, Iran, Israel, Italy, Jordan, Kenya, Malaysia, Mali, Mauritania, Mauritius, Morocco, Norway, Oman, Pakistan, Panama, Peru, Poland, Portugal, Romania, Russia, Senegal, Slovakia, Sudan, Switzerland, Syria, Tunisia, Turkey, Uganda and Ukraine.

## Credits

### **Managing Editor**

Jeremy Cherfas

### **Editor**

Thorgeir Lawrence

### **Writers**

Jeremy Cherfas, Richard Sanders, Katie Taft

### **Design and Layout**

Maxtudio

### **Cover illustration**

Greg Morgan

### **Photos**

Paola de Santis p 2-3, 6; Tim Murray p 3; Forest & Kim Starr p 6; Pascale Lepointe p 8; Frederik van Oudenhoven p 9; Patrick Maundu p 10; Stefano Padulosi p 12; Neil Palmer p 13; Scott Black p. 19; Moreno Maggi p. 20, 22; Saverio Villirillo p 21, 23; Barbara Vinceti pp 24-27.

### **Printing**

Ugo Quintily S.p.A.



# Annual Report

# 2010

## **Citation**

Bioversity International. 2011.  
Annual Report 2010.  
Bioversity International,  
Rome, Italy.  
ISBN 978-92-9043-898-4

Bioversity International,  
Via dei Tre Denari 472/a,  
00057 Maccarese, Rome, Italy

© Bioversity International, 2011